Chapter III

MARINE MAMMALS AND OCEAN ENERGY

Worldwide demand for energy is increasing, and a significant portion of that energy is taken from the marine environment. The development of energy resources poses certain risks to the oceans. How our society addresses the risks reflects its commitment to environmental sustainability in the face of considerable economic stress. That commitment was tested in the summer of 2010 when the United States experienced one of the largest environmental catastrophes in history—the Deepwater Horizon oil spill. The spill and response were massive but, arguably, the response was only marginally effective because oil containment and cleanup methods have not kept pace with advances in deepwater drilling technology. The public was greatly concerned about the spill but, over time, shifted its concern to the loss of jobs in a region that long ago had become dependent on oil production as a mainstay of its economy.

Although considerable research and monitoring was initiated during and after the spill, understanding the full impact of the Deepwater Horizon spill on marine mammals and other living marine resources will be challenging due to inadequate information on pre-spill (i.e., baseline) environmental conditions. Looking backward, scientists reviewing the *Exxon Valdez* spill in 1989 placed great emphasis on the collection of baseline information. Such information was not collected for most of the marine mammals in the Gulf of Mexico, despite decades of oil and gas development and other, extensive human-activities in those waters. Looking forward, the extent to which such lessons will be heeded in the Arctic is not clear. It is clear that drilling in the Arctic will be confounded by a much harsher environment, extensive logistical challenges, and inadequate response infrastructure.

Growing demands for clean energy sources are prompting greater investments in the development of offshore renewable energy resources. As with oil and gas, the development of renewable energy sources must proceed in a thoughtful and deliberate manner, with similar attention to the collection of baseline information to understand and minimize any adverse environmental effects from that new technology. Although energy independence is an important goal for the United States, adequate safeguards also are essential to protect an increasingly industrialized and rapidly changing marine environment.

The Deepwater Horizon Oil Spill

On 20 April 2010 BP's mobile offshore drilling unit Deepwater Horizon exploded and burned, and subsequently sank in the Gulf of Mexico 52 miles southeast of Venice, Louisiana (Figure III-1). Eleven of the 126 workers on the rig were killed and, over the following 86 days, an estimated 206 million gallons (4.9 million barrels[1]) of oil spilled into the Gulf (NOAA 2010, Federal Interagency Solutions Group 2010). This was the largest accidental oil spill ever reported.[2] In comparison, the Ixtoc I exploratory well spilled approximately 140 million gallons (3.5 million barrels) in the Bay of Campeche, Mexico, in 1979 (Jernelöv and Lindén 1981) and the *Exxon Valdez* tanker spilled approximately 11 million gallons (257,000 barrels) of crude oil into Prince William Sound, Alaska, in 1989.[3]

[1] One barrel of oil equals 42 U.S. gallons.

[2] In January 1991 an even larger oil spill occurred in the Persian Gulf, but in that case Iraqi forces intentionally released oil into the Gulf from a Kuwaiti offshore oil trans-shipment terminal and several oil tankers in an effort to slow the invasion of American troops. The total volume of released oil was unknown, but estimates have ranged from 84 to 520 million gallons. (Khordagui and Al-Ajmi 1993; Tawfiq and Olsen 1993).

[3] http://www.evostc.state.ak.us/facts/qanda.cfm

Oil spill response efforts

Figure III-1. Fire boat response crews battle the blazing remnants of the offshore oil rig Deepwater Horizon April 21, 2010. Multiple Coast Guard helicopters, planes and cutters responded to rescue the Deepwater Horizon's 126 person crew. (Source: U.S. Coast Guard)

On 29 April 2010, the U.S. Coast Guard declared the Deepwater Horizon incident a "Spill of National Significance," thereby marshalling extensive resources to respond. The response was massive, involving 13 federal agencies, multiple agencies from the five Gulf states, numerous local agencies, non-governmental organizations, oil companies and contractors, academia and private researchers, and thousands of local residents, volunteers, and expert consultants. In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan),[4] the Coast Guard established a Unified Command to coordinate the response efforts of federal and state governments and to execute national and regional contingency plans. The Unified Command structure was developed to ensure efficient and coordinated containment, dispersal, and removal of oil and hazardous substances while minimizing damage to the human and marine environment. The Unified Command linked the government agencies and other organizations responding to the spill, providing a forum for key parties to make consensus decisions.

Under the direction of the Unified Command, responders used both traditional and novel approaches to contain and recover the spilled oil. Traditional methods included booming and skimming the oil and in-situ burning. Responders also used planes to apply chemical dispersants, such as Corexit 9500A and 9527, onto the water surface. For the first time, responders also sought and obtained approval from the Environmental Protection Agency to inject Corexit 9500A directly at the wellhead at a depth of approximately 1500 m (Khatchadourian 2011, Kujawinski et al. 2011).

Several different techniques were used unsuccessfully to stop the flow of oil before a "capping stack" achieved that goal on 15 July 2010, 86 days after the explosion. A relief well intercepted and permanently capped the well on 19 September 2010.

Once the well was capped, the National Oceanic and Atmospheric Administration (NOAA) issued a report on the fate of the oil in the marine environment (NOAA 2010). Of the 4.9 million barrels discharged, approximately 17 percent of the oil was recovered directly from the wellhead, skimming and burning removed another 8 percent, and the other 75 percent was either chemically or naturally dispersed, evaporated/dissolved, metabolized by microbes (e.g., bacteria) or remained as "residual" oil either in the water column or on or buried in sediments (Figure III-2).

[4] The National Contingency Plan is authorized by the Federal Water Pollution Control Act, also known as the Clean Water Act.

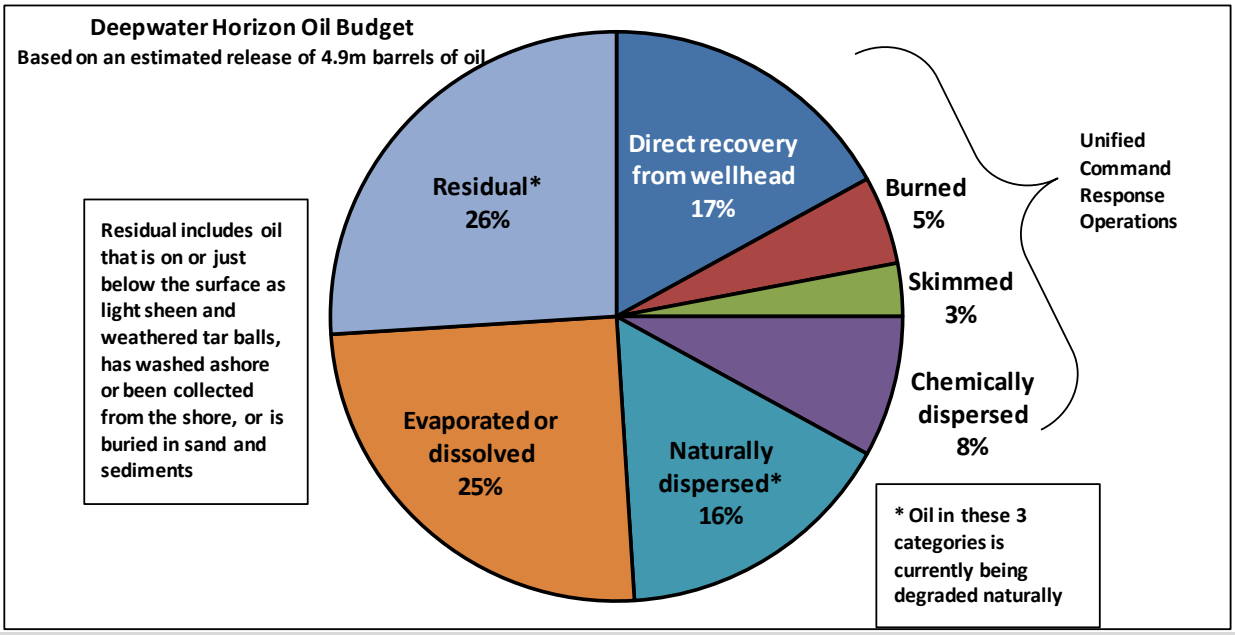

Figure III-2. Estimated fate of oil spilled after the Deepwater Horizon explosion (based on NOAA 2010)

The Deepwater Horizon oil spill presented a number of unique challenges compared to other spills in U.S. and international waters:

- **Amount**: As noted above, the amount of oil that escaped from the Deepwater Horizon wellhead was unprecedented, with an estimated peak flow rate of between 35,000 to 60,000 barrels (1.47 to 2.52 million gallons) per day—each week the spill released an amount of oil roughly equal to the entire *Exxon Valdez* spill.
- **Movement**: Until now, modeling of oil spill trajectories had been based on the movement of surface currents, winds, tides, and factors that affect the ocean surface. However, since the source of the release was deep underwater (at the wellhead), predicting how the oil and gas venting from the blow out would spread was a challenge for modelers (Ji et al. 2011). In addition, large amounts of oil and gas remained in the water column and little information or predictive capacity was available to model how the oil and gas would travel or weather at depth.
- **Type**: The oil released from the Deepwater Horizon wellhead was a mixture of both Louisiana sweet crude oil and gas (methane, ethane, and propane). Among other things, the composition of oil determines its toxicity, physical characteristics, and the rate that it weathers, all critical determinants of its potential effect on the Gulf ecosystem.
- **Dispersants**: At the height of the spill up to 15,000 gallons of chemical dispersants were applied daily at the wellhead—something that had never been done at this depth or scale before. In earlier stages of the spill, dispersants also were applied at the surface, and over the course of the spill more than 1.8 million gallons of dispersants were applied.[5] Dispersants reduce the surface tension of the oil, allowing it to break into smaller particles. Smaller particles have a larger surface-to-volume ratio, are more amenable to degradation by microbes, weather more quickly, and are less likely to form large slicks that cover and contaminate shorelines.

[5] http://www.restorethegulf.gov

- **In-water clean-up and containment**: Clean-up operations for oil in the water included containment of oil in booms, skimming of oil at the ocean surface, and in-situ burning. An unprecedented number of personnel, vessels, and aircraft were involved, working in coastal and pelagic habitats (Table III-1). Cleanup efforts generated significant amounts of liquid and solid waste. The final stages of containment involved seismic surveys around the wellhead to detect additional leaks. Almost all aspects of clean-up and containment activities had the potential to disturb marine mammals or displace them from important feeding or breeding grounds or other important habitat.

Table III-1. Statistics associated with the Deepwater Horizon response efforts (Source: Joint Information Center, http://www.restorethegulf.gov)

4.9	million barrels of oil spilled
47,829	responders at peak
9,700	vessels at peak
6,500	government vessels
3,200	commercial vessels of opportunity
127	surveillance aircraft
4,114	km of hard and soft boom deployed
1.8	million gallons of dispersants applied
>770,000	millions gallons subsea
1.07	million gallons at surface
411	in-situ burns conducted
265,450	barrels of oil burned
4	incident command posts (TX, LA, AL, FL)
32	equipment staging areas
1.4	million barrels of liquid wastewater collected
92	tons of solid waste collected

- **Baseline information**: A paucity of pre-spill baseline information on the status and health of marine mammals in the Gulf of Mexico significantly reduced the ability of the responsible authorities to make the before-and-after comparisons needed to determine the full effects of the spill on marine mammals.

Preliminary investigations into the causes of the spill

The loss of human life and the sheer size and scope of the spill prompted immediate investigations into what happened, how it happened, and how such information might be used to prevent a future spill. It also prompted changes in federal policy and organizational structure to address inadequacies and conflicts in the management of offshore oil and gas activities. A summary of the results of those investigations can be found below under the section "Lessons Learned."

The more prominent federal investigations initiated immediately following the explosion included:

- The Department of Homeland Security (Coast Guard) and the Department of the Interior (Minerals Management Service) launched a joint investigation on 27 April 2010 into the explosion and sinking of the Deepwater Horizon drilling rig, with the final report to be submitted within nine months of convening the Joint Investigation Team.
- The Department of the Interior established an Outer Continental Shelf Safety Advisory Board on 30 April 2010 to conduct a review of the Deepwater Horizon incident and, to report, within 30 days, on "what, if any, additional precautions and technologies should be required to improve the safety of oil and gas exploration and production operations on the outer continental shelf."
- The President established the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Oil Spill Commission) on 21 May 2010. The Oil Spill Commission was directed to examine the relevant facts and circumstances concerning the root causes of the Deepwater Horizon oil disaster, and to develop options for guarding against, and mitigating the impact of, oil spills associated with offshore drilling, taking into consideration the environmental, public health, and economic effects of such options. The results of the Oil Spill Commission's investigation were to be delivered to the President within six months of its first meeting.
- Several Congressional committees also investigated the oil spill, primarily in the form of hearings, to assess the potential short- and long-term effects on the environment and human health. On 10 June 2010, the Marine Mammal Commission's Executive Director testified before the House Subcommittee on Insular Affairs, Oceans, and Wildlife regarding the Deepwater Horizon Oil Spill

and its effects on marine mammals. He summarized the potential short- and long-term effects of oil spills on marine mammals, how best to assess the effects of the spill and response activities, and the likely impacts of oil and gas activities in the Gulf and elsewhere. Finally, he provided recommendations to the Subcommittee on ways to minimize the impacts of oil and gas operations on marine mammals and the marine ecosystems.[6]

Responding to injured and oiled marine wildlife

Responding to stranded marine wildlife, especially to those that may have been exposed to oil, was a high priority during the days and months immediately following the Deepwater Horizon oil spill. The National Contingency Plan outlines general procedures for minimizing effects of the oil spill and response activities on fish and wildlife and their habitat. Detailed procedures for wildlife response are outlined in Regional Area Contingency Plans. The Regional Area Contingency Plans for the Gulf (Regions IV and VI) identify the Fish and Wildlife Service as the lead agency for responding to endangered species, and NOAA as the lead agency for responding to the "living marine resources it manages and protects,"[7] which includes marine mammals, other protected marine species, and harvested marine fish. Wildlife response functions were the responsibility of the Unified Command's Wildlife Branch (Figure III-3).

The Wildlife Branch, with the recommendation and endorsement of NOAA NMFS, contracted with the Oiled Wildlife Care Network, a California-based oil spill response organization, to coordinate marine

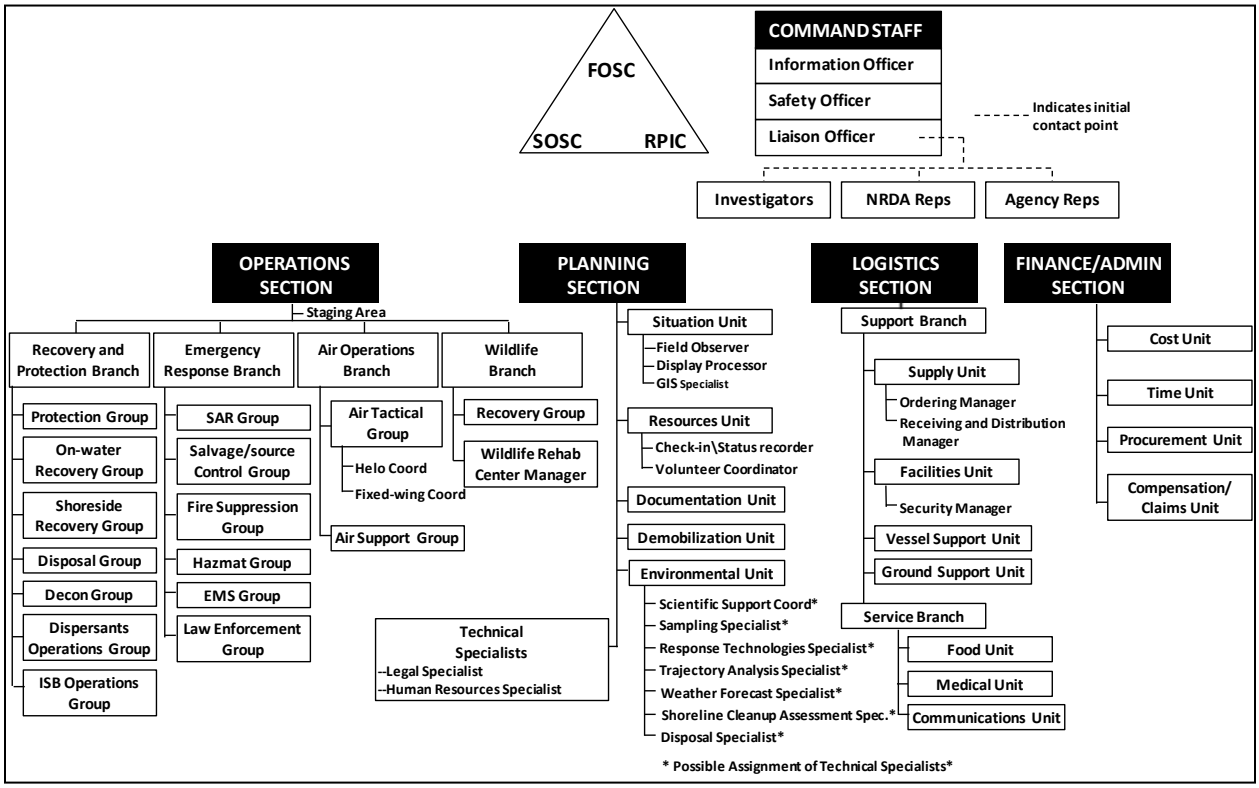

Figure III-3. Incident Command Structure for the Deepwater Horizon oil spill, in accordance with the National Contingency Plan. Wildlife response functions were under the Wildlife Branch of the Operations Section. (FOSC = Federal On-Scene Coordinator; SOSC = State On-Scene Coordinator; RPIC = Responsible Party In Charge)

[6] http://www.mmc.gov/testimony/pdf/testimony_061010.pdf
[7] http://www.nrt.org

mammal and sea turtle response efforts as the Marine Mammal and Sea Turtle Group in the Wildlife Branch.[8] In partnership with NOAA and the Fish and Wildlife Service, the Network applied NOAA's draft Marine Mammal Oil Spill Response Guidelines (Johnson and Ziccardi 2006), adapting them for Gulf species, including cetaceans and manatees. The Wildlife Branch, Marine Mammal and Sea Turtle Group, also trained regional stranding responders in hazardous materials, specific response sampling, and chain-of-custody protocols and coordinated the purchasing and distribution of supplies for collecting and archiving various types of samples. The Wildlife Branch relied heavily on the existing stranding network in the Gulf region to respond to stranded, distressed, or injured marine mammals, as those organizations already were federally authorized to conduct marine mammal stranding response activities under either section 112(c) or 109(h) of the Marine Mammal Protection Act. Several stranding network members or technical experts from outside the region also assisted with wildlife response.

Early in the response the Unified Command initiated aerial surveys to assess the extent of oil contamination. Those surveys provided a platform for opportunistic sightings of injured or dead marine mammals and other wildlife. In addition, the Wildlife Branch established a wildlife hotline for reporting oiled, injured, distressed, or dead marine mammals, sea turtles, and birds. Reports from the hotline and information from response vessels and aerial survey teams helped guide the Wildlife Branch's emergency response efforts. The Wildlife Branch defined the affected area for marine mammal and sea turtle response to include the central and eastern areas of the northern Gulf (from the Texas-Louisiana border to the Florida panhandle). The Wildlife Branch operated out of the Houma (Louisiana) Incident Command Post, with assistance from the Mobile (Alabama) Incident Command Post. The Wildlife Branch's Marine Mammal and Sea Turtle Group in the Command Posts was staffed primarily by NOAA employees. The Marine Mammal Commission also assisted in staffing the Mobile Incident Command Post for three weeks during the peak of the spill.

The Natural Resource Damage Assessment process

The Oil Pollution Act of 1990 requires federal, state, and tribal natural resource trustees to conduct a Natural Resource Damage Assessment (NRDA) following an oil spill to address resulting injuries. The trustees then determine the restoration actions needed to bring injured natural resources and services back to baseline conditions and make the environment and public whole with regard to spill-related losses (15 C.F.R. § 990.30). Therefore, concurrent with initial response activities, NOAA, the U.S. Fish and Wildlife Service, and the other natural resource trustees[9] initiated the pre-assessment phase of the natural resource damage assessment.

Natural resources include wildlife, such as marine mammals, sea turtles, seabirds, fishes, and invertebrates (e.g., corals, shrimps), and their habitat. Services include the functions of and benefits derived from those natural resources, such as those that support tourism, fishing, boating, marine products, and transportation. The responsible parties (i.e., those entities responsible for damages resulting from the incident) pay the costs of natural resource damages (including the costs of assessing such

[8] The Oiled Wildlife Care Network also coordinated the response to stranded sea turtles.

[9] Natural Resource Trustees are those officials of federal and state governments, Indian tribes, and foreign governments designated under authority of 33 U.S.C. 2706(b) of the Oil Pollution Act for the Deepwater Horizon incident. They include the Department of Commerce (National Oceanic and Atmospheric Administration), Department of the Interior (Fish and Wildlife Service, National Park Service, the Bureau of Indian Affairs, and the Bureau of Land Management), Department of Defense, and state agencies from the five affected coastal states (Florida's Department of Environmental Protection and Fish and Wildlife Conservation Commission; Alabama's Department of Conservation and Natural Resources and Geological Survey of Alabama; Mississippi's Department of Environmental Quality; Louisiana's Coastal Protection and Restoration Authority, Oil Spill Coordinator's Office, Department of Environmental Quality, Department of Wildlife and Fisheries, and Department of Natural Resources; Texas' Parks and Wildlife Department, General Land Office, and Commission on Environmental Quality) (75 Fed. Reg. 60800).

damage) and compensate the public for lost services derived from those natural resources, subject to statutory limitations.[10]

Regulations implementing the Oil Pollution Act specify three phases for conducting natural resource damage assessments: (1) pre-assessment, (2) injury assessment and restoration planning, and (3) restoration implementation (15 C.F.R. § 990.10-990.66) (Figure III-4). The pre-assessment phase consists of collecting and analyzing information to determine whether injuries to natural resources have occurred and whether to pursue restoration under additional provisions of the Act. Those activities can include collecting time-sensitive data (such as data collected from the affected area before it was exposed to oil), reviewing scientific literature about the oil and its impact on coastal resources, and making a preliminary determination regarding the extent and severity of injury.

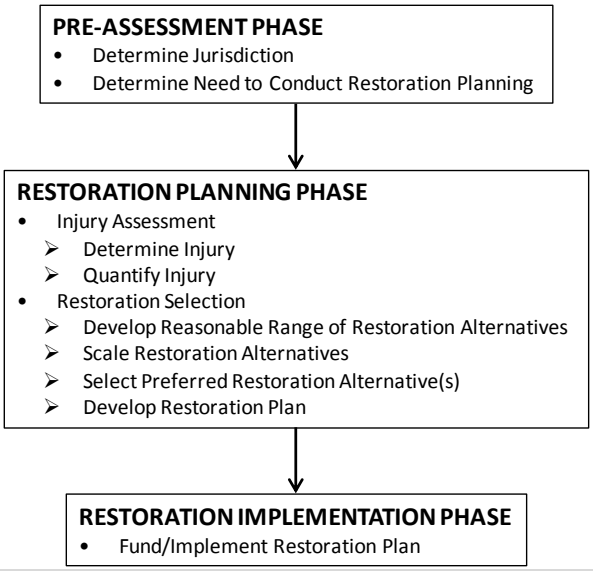

Figure III-4. Phases involved in a natural resource damage assessment under the Oil Pollution Act of 1990 (NOAA)

If the trustees determine that (a) injuries have been caused by the incident, (b) response activities cannot address the injuries, and (c) restoration activities exist to remedy the injuries, they will then move on to the injury assessment and restoration planning phase. During that phase, trustees must assess injuries caused by the spill and develop a plan for restoring the environment to remedy those injuries. The trustees conduct both scientific and economic injury assessments and restoration planning with the participation (and funding) of the responsible parties in a process known as "cooperative assessment." However, final authority over determinations of injury and restoration alternatives is retained by the trustees. Trustees are required to provide the public with at least one opportunity to comment on proposed restoration plans. Once they approve a final restoration plan, they work with the public and the responsible parties to implement the plan by conducting restoration projects during the restoration implementation phase. Completion of all three phases can take months to years, depending on the size and extent of the spill, and other factors.

Potential effects of an oil spill on marine mammals and the Gulf ecosystem

Many marine mammal stocks in the Gulf may have been, and may continue to be, affected by the Deepwater Horizon spill. Soon after the spill began, the Marine Mammal Commission compiled all relevant studies of oil impacts on marine mammals and consulted with the Services and academic experts on response options. That process culminated in publication of a report entitled "Assessing the long-term effects of the BP Deepwater Horizon oil spill on marine mammals in the Gulf of Mexico: A statement of research needs."[11] The following sections present information gathered during that process.

In general, the effects of an oil spill are expected to be manifested first at the level of the individual animal, either directly (e.g., contact with oil or dispersants, interactions with response activities) or indirectly (e.g., degradation of habitat, reduced availability of prey). Significant acute or chronic exposure

[10] The current limit on the liability of responsible parties for damages due to an oil spill from an offshore facility such as the Deepwater Horizon is $75 million under the Oil Pollution Act, plus any removal (i.e., cleanup) costs, unless the responsible party for the spill showed gross negligence, willful misconduct, or a failure to comply with federal operating, construction, or safety regulations, in which case the limit does not apply (33 U.S.C. § 2704).
[11] http://www.mmc.gov/reports/workshop/pdf/longterm_effects_bp_oilspil.pdf

could affect an individual's ability to survive and reproduce and, subsequently, the survival and reproductive rates of the affected population. The full nature and extent of any effects will depend on a variety of factors, such as the—

- chemical constituents of the oil and dispersants, which change over time as oil and dispersants degrade and are metabolized;
- dose of exposure (i.e., amount and duration);
- route of exposure (e.g., inhalation, ingestion, external contact, transplacental);
- type and trophic level of prey (e.g., fish, invertebrates) or forage (i.e., seagrass) consumed and their contaminant levels;
- marine mammal species involved; and
- physical and physiological characteristics of the affected individuals (e.g., age, sex, reproductive and health status).

Current understanding of the potential effects of oil on marine mammals is based on information from (1) effects observed during or after other oil spills (Geraci and St. Aubin 1990, Loughlin et al. 1994, Smultea and Würsig 1995, Bickham et al. 1998, Bodkin et al. 2002, Boehm et al. 2007, and Matkin et al. 2008), (2) a small number of controlled exposure studies using captive marine mammals (Geraci et al. 1983, Smith et al. 1983, St. Aubin et al. 1985), (3) simulations and in vitro studies (Braithwaite et al. 1983, Godard et al. 2004), and (4) effects observed during accidental and controlled oil exposure of species other than marine mammals (Bickham et al. 1998, Mazet et al. 2001, Golet et al. 2002, Mohr et al. 2007, Esler et al. 2010). Current information does not provide a sufficient basis for predicting, with full confidence, the severity of either short- or long-term effects of the Deepwater Horizon spill on marine mammals. However, it does provide ample evidence that exposure to oil can harm marine mammals.

For example, inhalation of specific volatile organics from some types of oil can cause respiratory irritation, inflammation, or emphysema. Similarly, ingestion of oil may cause gastrointestinal inflammation, ulcers, bleeding, diarrhea, or maldigestion. Certain inhaled and ingested chemicals in oil also may damage organs such as the liver, kidney, adrenal glands, spleen, and brain; cause anemia, cancer, congenital defects, and immune system suppression; or lead to reproductive failure. Chemical contact may cause skin and eye irritation; inflammation; burns to mucous membranes, mouth, and nares; or increased susceptibility to infection. Oil mixtures can physically foul the baleen of mysticete whales, which is used to filter food.

Response activities to contain and remove spilled oil also may affect marine mammals. Increased vessel and air traffic may disrupt foraging, habitat use, daily or migratory movements, and behavior (e.g., social interactions such as mother-calf bonding, breathing, and resting patterns) (Nowacek et al. 2001, Constantine et al. 2004, Williams et al. 2006, Stensland and Berggren 2007, Lusseau et al. 2009). Increased vessel traffic also increases the risk of vessel strikes (Laist et al. 2001, Fish and Wildlife Service 2001, Bechdel et al. 2009), although none were reported during the prolonged spill and response phase. Noise from seismic surveys (such as those used to detect potential leaks around the wellhead) or other response-related activities may also cause disturbance or displacement, hearing loss (temporary or possibly permanent), or other physical injury to marine mammals (McCauley et al. 2000, National Research Council 2003). In the Gulf of Mexico, seismic survey mitigation measures state that seismic survey work must pause when sperm whales or other cetaceans are closer than 0.5 km to a seismic sound source array and that the seismic sound source must not be restarted until survey vessel has moved another 0.5 km away from the marine mammals.[12]

In the Gulf, responders used large quantities of the dispersant Corexit at the sea surface (e.g., Corexit 9527, Corexit 9500A) and at the wellhead (Corexit 9500A) (Kujawinski et al. 2011). The long-term effects of dispersants on marine mammals are largely unknown (National Research Council 2005). The

[12] http://www.nmfs.noaa.gov/ocs/mafac/meetings/2010_06/docs/mms_2007_ntl.pdf

Regional Response Team had pre-approved the use of Corexit prior to the spill because it is listed on the National Contingency Plan product schedule maintained by the Environmental Protection Agency. The Environmental Protection Agency was consulted and concurred on decisions related to the volume of dispersants used in response to the spill, while also conducting additional toxicity tests during the spill. Those tests are helping to describe the potential for adverse effects from exposure to dispersants.

Responders also use hard and soft boom and skimmers to contain and collect surface oil and in-situ burning to remove it, and those activities also may affect marine mammals both through direct interaction and displacement from habitat. Burning reduces the overall amount of oil in the water, but also leaves behind a residue of uncertain composition and toxicity (Benner et al. 1990, Wang et al. 1999). Burning also releases additional chemicals into the air, posing additional inhalation risks that will vary based on the level of exposure.

Oil spills may affect marine mammals indirectly by altering the marine ecosystem and the key features of their habitat (Paine et al. 1996, Golet et al. 2002, Peterson et al. 1996, National Research Council 2002). Such effects could include reductions in animal or plant biomass, shifts in prey or seagrass distribution, or contamination of prey or seagrass. In Prince William Sound, Alaska, oil from the *Exxon Valdez* spill accumulated in sediments, continues to contaminate nearshore environments, and appears to have impeded recovery of sea otters (Bodkin et al. 2002). How long that effect will persist is uncertain (Page et al. 2002, Rice et al. 2003, Neff et al. 2006, Boehm 2007). In the Gulf, spilled oil that has accumulated in coastal and offshore bottom sediments could be re-released during hurricanes and storms, with intermittent, recurring effects on the marine ecosystem (Machlis and McNutt 2010). Further research is needed to characterize physical and biogeochemical degradation rates in the Gulf of Mexico and to evaluate the likelihood of such long-lasting impacts.

A full assessment of the damages that resulted from the Deepwater Horizon oil spill will likely take many years and require integration and analysis of multiple types of information. Those include measures and comparisons of the ecological, biological, geophysical, chemical, and oceanographic conditions in the Gulf, both pre- and post-spill, and/or modeling of conditions where pre- and/or post-spill information is not available. Such an assessment also will require an understanding of other human-related risk factors in the Gulf and their role in the health of the marine ecosystem.

Confounding factors

A number of factors and events could potentially complicate assessment of the injuries from the Deepwater Horizon oil spill to the Gulf ecosystem and the marine mammals it supports. Some Gulf marine mammal populations have experienced multiple unusual mortality events (UMEs) in the last two decades. NOAA's National Marine Fisheries Service has declared 18 UMEs in the Gulf since 1991, 11 of which involved cetaceans (primarily bottlenose dolphins) and eight of which involved manatees. The cause was determined for nine events: eight were caused by biotoxins and one was caused by an infectious disease.[13]

In February 2010, just prior to the spill, an unusually high number of bottlenose dolphins began to strand in the northern Gulf. In March 2010 NOAA began consultation with the Working Group for Marine Mammal Unusual Mortality Events (Working Group) to determine whether the increase in strandings constituted an unusual mortality event (in accordance with section 404 of the Marine Mammal Protection Act). When the spill occurred, the consultation was delayed until NOAA could reanalyze the data on marine mammal deaths along the northern Gulf before, during, and after the oil spill. Consultation with the Working Group was reinitiated in October 2010 (six months after the spill) and, in December of that year, NOAA declared the deaths an unusual mortality event. Since then, strandings continue to be elevated in the northern Gulf, and have involved a large percentage of premature, stillborn, and neonatal bottlenose dolphins.

[13] http://www.nmfs.noaa.gov/pr/health/mmume/

To the extent practicable, NOAA and the Working Group are coordinating the investigation of those deaths (pre-, during, and post-oil spill) with ongoing NRDA activities where the data and analytical needs of those two processes coincide. At the end of 2011, the unusual mortality event and the investigation of it were still ongoing. The experts have not determined the cause or causes of the UME, but 13 of the 58 bottlenose dolphins that died in the northern Gulf during that event have tested positive for the bacterium *Brucella*.[14] *Brucella* infections in Gulf of Mexico dolphins are not new and the role of *Brucella* in the unusual mortality event is currently unknown.

Other anthropogenic activities and natural perturbations in the Gulf complicate assessment of marine mammal injuries from the spill. They include ongoing seismic surveys for oil and gas, routine oil and gas operations (drilling, production, transport, and decommissioning), commercial and recreational fisheries, commercial shipping, military activities, tourism, recurring hypoxic and anoxic conditions, harmful algal blooms, hurricanes, natural oil seeps, and climate disruption. An assessment of injuries also may be confounded by changes in the physical and biogeochemical properties of Deepwater Horizon oil over time as the result of natural weathering and degradation.

Assessing the relative contributions of direct and indirect factors and determining their relative and combined effects on the long-term survival and reproduction of the Gulf's marine mammals is a considerable challenge. The challenge is made even more difficult because the resources available are not sufficient for a comprehensive assessment.

Marine mammal response and assessment activities

Efforts to locate and respond to stranded marine mammals in the Gulf expanded at the same time that scientists initiated the pre-assessment phase of the natural resource damage assessment. To achieve both goals (response and damage assessment), NOAA and the Fish and Wildlife Service initially conducted the following activities—

- **Aerial and vessel surveys**: used to track movements of selected marine mammal stocks, document their direct exposure to oil, and describe their physical and/or behavioral reactions if and when they came into contact with oil;
- **Blood and tissue sampling**: collected from stranded marine mammals and intended to help assess oil exposure;
- **Passive acoustic monitoring**: used near the Deepwater Horizon wellhead to detect the presence of vocalizing marine mammals; and
- **Visual observations**: used to assess and minimize marine mammal/vessel interactions during the height of skimming and burning operations.

The initial response phase extended temporally from 30 April through 2 November 2010 and spatially from the Texas-Louisiana border to the Florida panhandle. In accordance with criteria it had approved, the Unified Command reinstated response efforts from 3 December 2010 to 24 May 2011 for portions of Louisiana from St. Mary's Parish east to the Louisiana/Mississippi border because of continued strandings of visibly oiled dolphins. On 25 May 2011 the marine mammal response phase of the oil spill ended and no further funding or direction was received from the Unified Command even though additional oiled cetaceans were subsequently found. On 25 May 2011 the Unified Command terminated its responsibility for marine mammal response efforts in the northern Gulf, passing that responsibility back to NOAA's Marine Mammal Health and Stranding Response Program. This ended the responsibility of the Unified Command and responsible parties to pay for response activities. However, NOAA's Marine Mammal Health and Stranding Response Program was still encumbered by National Resource Damage Assessment requirements.

[14] http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010_brucella.htm

Table III-2. Dolphin and whale stranding data by species, 30 April 2010 through 17 April 2011 (NOAA)

Cetacean species	Alive	Dead	Condition unknown	Total
Bottlenose dolphins (*Tursiops truncatus*)	9	142	4	155
Kogia spp.	0	2	0	2
Melon-headed whale(*Peponocephala electra*)	0	2	0	2
Spinner dolphin (*Stenella longirostris*)	3	3	0	6
Sperm whale (*Physeter macrocephalus*)	0	2	0	2
Unknown species	1	2	1	4
Total	13	153	5	171

Throughout the response phase the Wildlife Branch compiled daily reports of the numbers of marine mammals, sea turtles, and birds collected (alive or dead), and identified them as either visibly oiled, without visible oil, or pending further information. The Unified Command used the daily reports to direct response and surveillance activities and to update the public and the media. Table III-2 provides a summary of all marine mammal strandings reported during the response phase, by species; Figures III-5 and III-6 show the locations of all marine mammal strandings, by species, that were reported to NOAA during the initial and reinstated response stages, respectively.[15]

In May 2010 the trustees established a technical working group for marine mammals and sea turtles.[16] The group, still active at the end of 2011, is comprised of scientists and other representatives from federal and state trustee agencies and contracted consultants and academicians. The regulations implementing the Oil Pollution Act (15 C.F.R. §990) also require that the responsible parties be invited to participate in the damage assessment process, and the trustees coordinated with BP throughout the process.[17] BP's involvement in the review of work plans expedited funding for the costs associated with implementing those work plans. Any work plans or components of work plans that BP did not approve, including stranding response, could be implemented independently by the trustees. The trustees could then seek reimbursement as part of the final damage assessment settlement.

In 2010 and 2011 the Marine Mammal and Sea Turtle Technical Working Group developed several work plans to obtain additional information needed for the natural resource damage assessment. Initial plans focused on short-term assessment, including (1) documenting exposure of particular marine mammals and sea turtles and their habitats in oiled areas, (2) assessing the effects of oil spill response activities (i.e., cleanup), (3) gathering and analyzing baseline information, and (4) filling other data gaps. Natural resource damage assessment projects for marine mammals conducted by the technical working group in 2010 and 2011 included—

- biopsy sampling of bottlenose dolphin populations at four sites (Barataria Bay, Louisiana; Chandeleur Sound, Louisiana; Mississippi Sound, Mississippi; and St. Joseph Bay, Florida);

[15] http://www.nmfs.noaa.gov/pr/health/oilspill/mammals.htm
[16] http://www.gulfspillrestoration.noaa.gov/oil-spill/gulf-spill-data/
[17] The responsible parties designated for the Deepwater Horizon oil spill include BP Exploration and Production Inc., as well as Transocean Holdings Inc., Triton Asset Leasing GmbH; Transocean Offshore Deepwater Drilling Inc.; Transocean Deepwater Inc.; Anadarko Petroleum; Anadarko Exploration & Production Company LP; and MOEX Offshore 2007 LLC (75 Fed. Reg. 60800).

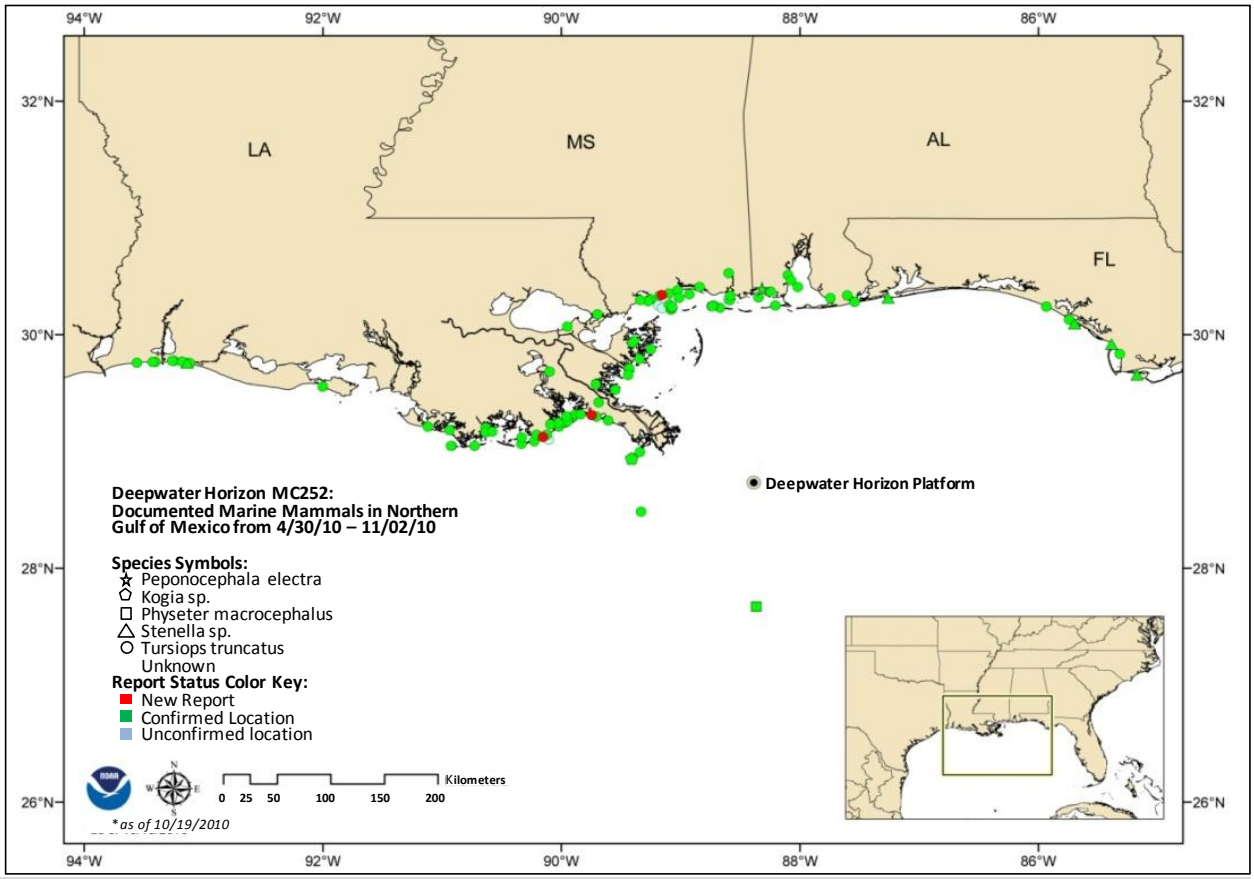

Figure III-5. Location and species identification of marine mammals stranded during the initial response to the Deepwater Horizon oil spill, 30 April–2 November 2010 (NOAA)

- mark-recapture photo-identification surveys in three sites (Barataria Bay, Louisiana; Mississippi Sound, Mississippi; and St. Joseph Bay, Florida); large-vessel pelagic research cruises to—
- visually assess and photo-document marine mammal contact with oil and occurrence of marine mammals in oiled areas;
- deploy satellite tags and collect biopsy samples from Bryde's whales, sperm whales, and other marine mammals in offshore waters;
- collect habitat information, including surface hydrographic data, temperature profiles, salinity, dissolved oxygen, and acoustic echo-sounder backscatter information to characterize water column productivity and prey resources; and
- deploy and recover low and mid-frequency passive acoustic monitoring buoys;
- aerial surveys to estimate abundance and distribution of marine mammals in oil-affected areas, document locations of manatees in distress, and inform rescue efforts;
- live capture-release studies of bottlenose dolphins in Barataria Bay, Louisiana, and Sarasota Bay, Florida, to assess sub-lethal and chronic health impacts;
- genetic analyses of biopsy and stranding samples for species identification, sex determination, and/or stock structure;
- analysis of manatee movements;
- sampling of nearshore and pelagic prey; and
- sampling of seagrass for evidence of oil.

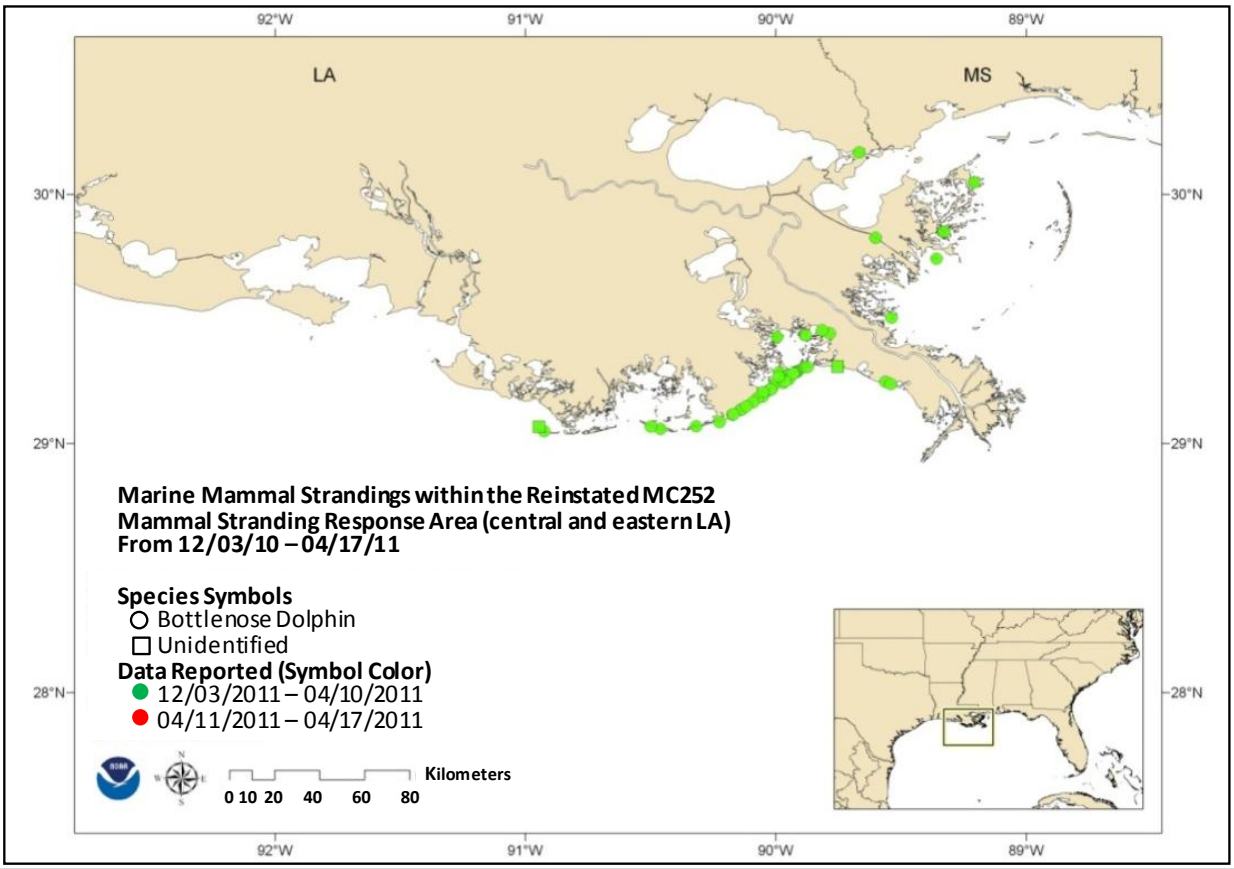

Figure III-6. Location and species identification of marine mammals stranded during the reinstated response for the Deepwater Horizon oil spill, 3 December – 17 April 2011 (NOAA)

The Commission's Executive Director and Energy Policy Analyst visited the Gulf in August 2010 and met with personnel involved in both response and assessment at the Deepwater Horizon Incident Command Centers in New Orleans (Louisiana), Houma (Louisiana), and Mobile (Alabama). They participated in a photo-identification survey of bottlenose dolphins in Mississippi Sound, Mississippi, and an aerial survey of marine mammals and sea turtles out of Mobile, Alabama, both coordinated by NOAA.

Assessment tools and preliminary data

During the oil spill, NOAA launched its Emergency Response Management Application (ERMA), a web-based Geographic Information System tool designed to assist both emergency responders and environmental resource managers involved in response and assessment. ERMA provides a visual display of the features and baseline information for the Gulf of Mexico and also of information collected during and after the spill (Figure III-7). It also provides a link to a wide variety of preliminary data collected during response and assessment activities, including data on marine mammal strandings. Additional information on that valuable tool and data collected during response and assessment efforts can be found at NOAA's ERMA website.[18]

[18] http://www.response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma/erma-gulf-response.html

Table III-3. Marine mammal stocks in the Gulf of Mexico (NOAA)

Sperm whale[1]	Bryde's whale	Killer whale
Cuvier's beaked whale	Atlantic spotted dolphin	False killer whale
Blainville's beaked whale	Pantropical spotted dolphin	Pygmy killer whale
Gervais' beaked whale	Striped dolphin	Dwarf sperm whale
Bottlenose dolphin (oceanic)	Spinner dolphin	Pygmy sperm whale
Bottlenose dolphin (continental shelf)	Rough-toothed dolphin	Melon-headed whale
Bottlenose dolphin (coastal – 3 stocks)	Clymene dolphin	Risso's dolphin
Bottlenose dolphin (bay, sound, estuary –32 stocks)	Fraser's dolphin	Pilot whale, short-finned
West Indian manatee (coastal - 1 stock)[1]		

[1]Listed as endangered under the Endangered Species Act

Baseline information on Gulf of Mexico marine mammal stocks

When an event such as the Deepwater Horizon oil spill occurs, the natural resource damage assessment would benefit greatly by the availability of adequate baseline information on the resources within the affected area. The Gulf of Mexico supports a variety of marine mammals, including 21 cetacean species and 1 sirenian (Waring et al. 2010, Table III-3). Those species comprise 57 stocks, 37 of which are bottlenose dolphin stocks. The National Marine Fisheries Service has management responsibility for the cetacean species and the Fish and Wildlife Service has responsibility for the Florida subspecies of the West Indian manatee. Section 117 of the Marine Mammal Protection Act requires the National Marine Fisheries Service and the Fish and Wildlife Service to prepare stock assessments for each stock of marine mammals occurring in waters under the jurisdiction of the United States.

Existing information on the status of the majority of marine mammal stocks in the Gulf falls well short of that required under the Marine Mammal Protection Act and that needed to assess their pre-spill status and vulnerability to various risk factors. The necessary information includes stock structure, distribution, abundance, movement patterns, age structure, reproductive rates, survival rates, and health (nutritional status, immune function, and exposure to contaminants, biotoxins, and pathogens).

The lack of adequate research infrastructure in the Gulf (especially logistic support) prior to the spill has been a significant impediment to conducting surveys and other assessment studies. The pre-spill studies generally focused on specific topics (e.g., response of sperm whales to seismic surveys). As a result, little multi-year funding before the spill was directed toward understanding the full spectrum of risks to marine mammals and the cumulative effects of multiple risk factors, despite the fact that the Gulf is highly industrialized and multiple marine mammal unusual mortality events have occurred there over the past 20 years.

Comprehensive data collection efforts by NOAA and the Fish and Wildlife Service for the pre-assessment phase of the natural resource damage assessment do not provide a substitute for the baseline data that should have been collected for Gulf marine mammal stocks prior to the spill. Nonetheless, the data collected will be useful for characterizing marine mammal movements and behavior immediately before, during, and after oil and chemical dispersants reached key coastal and deepwater habitats. Thus, they also provide an important reference for assessing the effects of the spill and response activities.

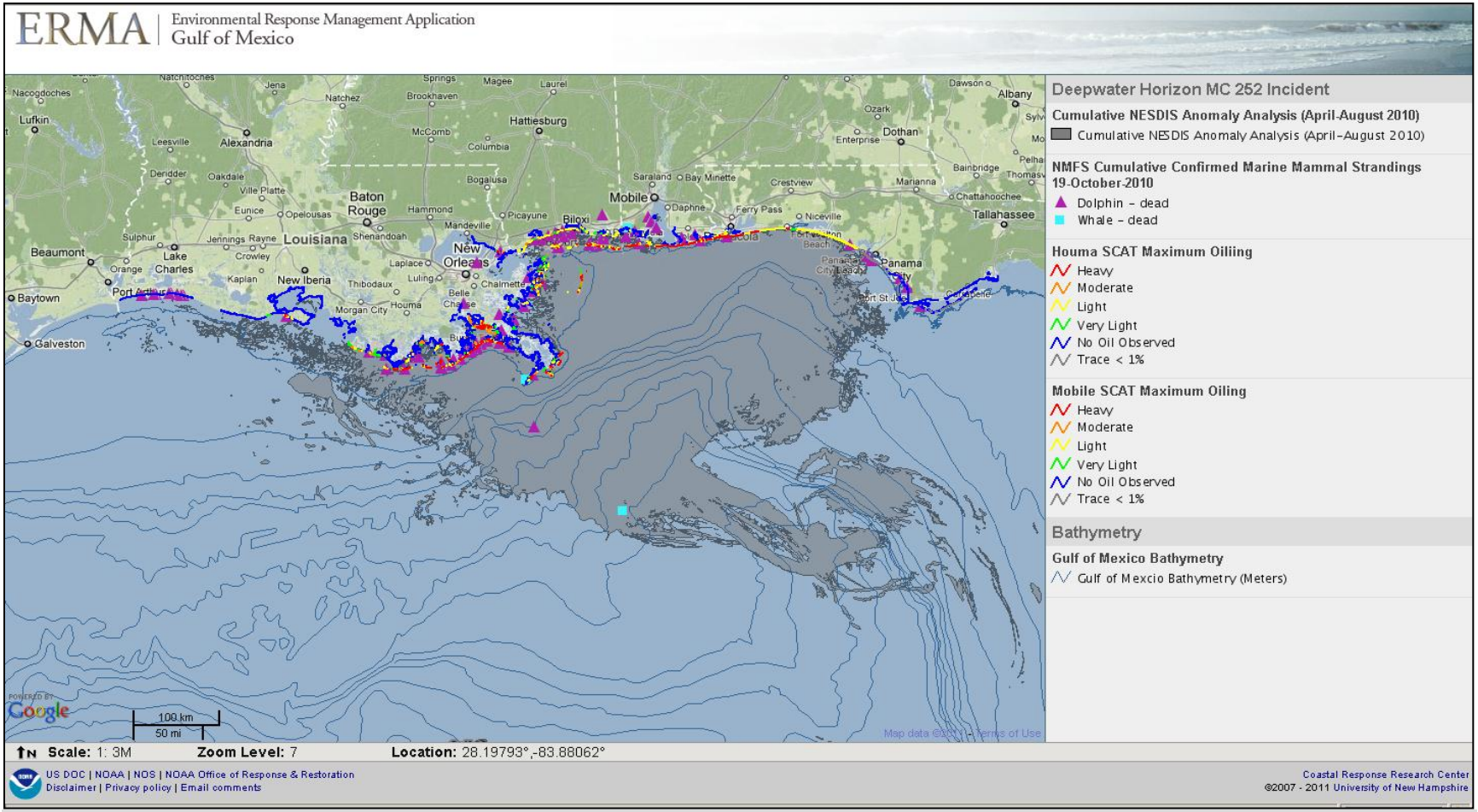

Figure III-7. ERMA map showing cumulative oil spill coverage offshore, marine mammal strandings, and maximum shoreline oiling (NOAA)

Interagency meeting on oil spill preliminary effects and long-term monitoring needs

In August 2010 the Marine Mammal Commission convened a meeting of scientists and managers from several federal agencies working on the Deepwater Horizon oil spill response and assessment efforts. The goals of the interagency meeting were to (1) share information on agency efforts to assess impacts of the oil spill on marine mammal populations in the Gulf of Mexico, (2) identify existing information gaps and ways to address them, and (3) consider information needs as agencies shifted to long-term monitoring of the Gulf ecosystem. In addition to the Marine Mammal Commission, agencies represented at the meeting were NOAA, the Fish and Wildlife Service, the Bureau of Ocean Energy Management, Regulation, and Enforcement (formerly the Minerals Management Service), the U.S. Coast Guard, the Navy, the Office of Naval Research, and the National Science Foundation. NOAA and Fish and Wildlife Service scientists presented preliminary information collected from response and assessment activities to date. They also identified significant data gaps in baseline information on marine mammals and on the possible effects of oil exposure on Gulf marine mammal populations.

Participants at the meeting indicated that they could not be certain that work plans and monitoring programs established under the natural resource damage assessment process would be in place long enough to detect and quantify long-term (five years or more) changes in status or distribution of marine mammal populations, especially for those stocks for which baseline information is scarce and/or access to animals has been limited. For that reason, they gave high priority to the development of a comprehensive plan to address long-term monitoring needs for marine mammals in the Gulf. The Commission agreed to take the lead in developing such a plan and sought input from NOAA's National Ocean Service and National Marine Fisheries Service, the Fish and Wildlife Service, and the Bureau of Ocean Energy Management, Regulation, and Enforcement as it developed the plan.

The Marine Mammal Commission's statement of research needs

In August 2011 the Commission released the long-term monitoring plan in the form of a report "Assessing the long-term effects of the BP Deepwater Horizon oil spill on marine mammals in the Gulf of Mexico: A statement of research needs."[19] The report outlined the legal mandates for assessing a spill's overall effects and reviewed the likely effects of oil spills on marine mammals. It characterized research efforts to date, highlighted the overall need to improve assessment and monitoring of the Gulf's marine mammals, and outlined priorities for future efforts.

The Commission believes that assessment and monitoring efforts should be given high priority during or immediately after a spill to document exposure and make preliminary determinations regarding resources most affected by the spill and response activities. The Commission acknowledges that the likelihood of detecting certain effects decreases with time and the utility and value of certain types of research decline accordingly. Because agencies tend to focus on immediate assessment and monitoring, the Commission's report focused on tasks aimed at understanding potential long-term effects on Gulf marine mammals, including—

- **Evaluating the effect of exposure to oil or dispersant-related contaminants on physiological functions (immune, reproductive, and other vital systems)**: This involves assessing the health status and contaminant loads of stranded or live-captured animals, conducting necropsies of dead animals, assessing reproductive rates and indications of reproductive failure (e.g., aborted fetuses, malformed offspring), controlled exposure experiments, and genomic analyses;
- **Assessing oil and/or response-related changes in the ecosystem resulting in a reduction in prey availability**: This involves evaluating the body condition of live and stranded animals, looking for changes in diet as determined by observations of foraging behavior and stomach/intestinal content analyses, and prey surveys to assess biomass and changes therein over space and time;

[19] http://www.mmc.gov/reports/workshop/pdf/longterm_effects_bp_oilspil.pdf

- **Evaluating how oil and/or response activities may have led to ecosystem changes that are harmful to marine mammals (e.g., harmful algal blooms, hypoxia or anoxia)**: This involves observations of stranded animals and stranding patterns, analyses of tissues for evidence of toxins, and monitoring of harmful algal blooms and hypoxic/anoxic zones; and
- **Determining the extent to which exposure to oil and/or response activities leads to a reduction in status of marine mammal populations involving individual fitness, population vital rates (survival and reproduction), and population abundance and trends**: This involves observations of mortality rates and evidence of reproductive failure, and aerial, vessel, shoreline, and acoustic surveys to assess relative or absolute changes in numbers of animals, especially mother/calf pairs.

The statement of research needs was submitted to the Senate Committee on Commerce, Science and Transportation on 8 August 2011, as part of the administrative record for its 20 July 2011 hearing on "Looking to the Future: Lessons in Prevention, Response, and Restoration from the Gulf Oil Spill." It also was distributed to several federal and state government agencies, research organizations, and conservation groups working in the Gulf and nationally on marine mammals and oil and gas related activities.

Independent studies of oil spill effects

As unfortunate as it was, the spill created an opportunity to learn about the effects of oil spills and response activities on marine ecosystems. The natural resource damage assessment will provide much valuable information, but that information should be supplemented by independent, hypothesis-driven scientific research. The need for such research was recognized soon after the spill and was facilitated by support from BP, the government, and private foundations.

On 24 May 2010, BP committed $500 million over a 10-year period to investigate the impacts of the spill on the Gulf ecosystem and affected states. The funds were used to create the Gulf of Mexico Research Initiative, a broad, independent research program to be conducted primarily by research institutions in the Gulf Coast states. The Research Initiative is overseen by an independent board of scientists selected by BP and the governors of the five Gulf states. The objective is to "investigate the impacts of the oil, dispersed oil, and dispersant on the ecosystems of the Gulf of Mexico and affected coastal States in a broad context of improving fundamental understanding of the dynamics of such events and the associated environmental stresses and public health implications." Funding has been awarded on a competitive basis, with the first year of funding (1 June 2010–31 May 2011) focused on rapid-response studies that could be implemented shortly after the spill. A wide variety of studies were implemented, including a study of the effects of oil on estuarine bottlenose dolphins in the Florida panhandle by the Florida Institute of Technology. Second year funding was for longer-term (three-year) projects.[20]

The National Science Foundation awarded a number of rapid-response grants to independent researchers immediately following the spill.[21] For marine mammals, they included awards to the University of Louisiana at Lafayette for modeling of marine mammal population trends using passive acoustic monitoring cues, and to Mote Marine Laboratory to help assess effects of sub-lethal oil exposure on critical biological functions of marine mammals and sea turtles. Private foundation funding for research on spill effects on marine mammals also was provided to the Chicago Zoological Society, the Ocean Alliance, the Dauphin Island Sea Laboratory, and others. The Gulf of Mexico Sea Grant programs website has a searchable database that provides summary information about research and monitoring activities related to the Deepwater Horizon oil spill.[22]

[20] http://www.gulfresearchinitiative.org/
[21] http://www.nsf.gov/awardsearch/advancedSearch.jsp; enter "5987" under "Reference Code" for Deepwater Horizon-related projects
[22] http://gulfseagrant.tamu.edu/oilspill/database.htm

Restoration planning

In October 2010 the trustees confirmed damage and injury to natural resources and issued a notice of intent to begin planning restoration activities (75 Fed. Reg. 60800). In accordance with the regulations implementing the Oil Pollution Act, restoration planning occurs concurrently with damage assessment—in essence, proposals for ecosystem restoration are being developed even before the nature and full extent of the damages have been determined. The emphasis on early restoration planning was designed to jump-start the restoration process, especially because the determination of final damages can be a protracted process.

During the planning stage, the trustees "fully evaluate, assess, quantify, and develop plans for restoring, replacing, or acquiring the equivalent of natural resources injured and losses resulting from the Deepwater Horizon incident" (75 Fed. Reg. 60800). Resources affected by the spill occurred in state and federal waters and throughout the water column. They included over 1,700 km (1,096 miles) of shoreline habitat, including salt marshes, sandy beaches, and mangroves; a variety of wildlife species including birds, sea turtles, marine mammals; benthic communities and fish; and areas used by humans for such things as swimming, fishing, beach-going, and enjoyment and viewing of wildlife.[23]

On 15 June 2010, President Obama announced that the Secretary of the Navy would lead development of a long-term Gulf Coast Restoration Plan. The Secretary consulted with or sought comments from fishermen, health officials, conservation workers, leaders of nonprofit organizations, local leaders, scientists, members of the business community, elected officials, and thousands of Gulf Coast residents. He released "America's Gulf Coast: A Long Term Recovery Plan after the Deepwater Horizon Oil Spill" in September 2010.[24] The plan's main recommendations were for—

- Congressional action to dedicate a significant amount of civil penalties recovered under the Clean Water Act from BP and the other responsible parties toward assisting the region where the damage from the spill occurred, with federal, state, local, and tribal actions coordinated by a Gulf Coast Recovery Council working in concert with the trustee agencies, and
- immediate establishment of a federal lead for Gulf recovery and the creation of a Gulf Coast Ecosystem Restoration Task Force to coordinate the recovery of the region's ecosystem.

By Executive Order on 5 October 2010, President Obama acted on the Secretary's recommendations and established the Gulf Coast Ecosystem Restoration Task Force. The order charged the Task Force with developing an ecosystem restoration plan to address both the damage caused by the Deepwater Horizon oil spill and the long-standing ecological decline of the Gulf, with the aim of moving toward a more resilient Gulf Coast ecosystem. The President also appointed Lisa Jackson, the Administrator of the Environmental Protection Agency, to Chair the Task Force. Members included representatives of several key federal departments and agencies, representatives of the five Gulf states, and elected officers of affected tribes. In establishing the Task Force, the President recognized that efforts to restore the Gulf had begun well before the Deepwater Horizon spill, and that a comprehensive strategy was needed that could incorporate ongoing activities, support the natural resource damage assessment process, and ensure that restoration efforts were coordinated and effective.

The Marine Mammal Commission sent a letter to Administrator Jackson in October 2010 noting the Commission's familiarity with the wide range of risk factors that affect marine mammals and marine ecosystems, including those posed by oil and gas activities. The Commission offered its assistance to the Task Force's efforts to guide restoration of the Gulf Coast. The Task Force did not respond.

The Task Force released its preliminary "Gulf of Mexico Regional Ecosystem Restoration Strategy" in October 2011. It outlined a framework for reversing widespread environmental degradation (much of it from before the spill) to ensure a healthy marine environment and economic future for the Gulf.

[23] http://www.restorethegulf.gov
[24] http://www.restorethegulf.gov/sites/default/files/documents/pdf/gulf-recovery-sep-2010.pdf

The final "Gulf of Mexico Regional Ecosystem Restoration Strategy," issued in December 2011,[25] established four overarching restoration goals—

- **Restore and conserve habitat**: expedite implementation and improve the effectiveness of state and federal programs related to landscape-scale resource management, habitat conservation and restoration strategies;
- **Restore water quality**: reduce the amount of nutrients flowing into the Gulf and undertake other measures to enhance water quality;
- **Replenish and protect living coastal and marine resources**: promote sustainable resource management that focuses on actions to conserve and restore viable populations of living coastal and marine resources and their coastal and offshore environments; and
- **Enhance community resilience**: integrate the creation of resilient communities with ecosystem restoration through the development of comprehensive coastal planning programs.

The Task Force recommended that resource agencies implement existing recovery and conservation plans and, where needed, develop plans for conserving threatened and endangered species. In the Gulf, the sperm whale and the West Indian manatee are listed as endangered under the Endangered Species Act. The responsible agencies have completed recovery plans for both, but implementation has been hampered for sperm whales by inadequate infrastructure (e.g., access to survey vessels) and for manatees by obstacles to protecting their habitat (e.g., coastal development, poor compliance with boat speed limits). The Task Force also recommended more monitoring to identify and track sentinel species and sites.

In its comments on the draft, the Commission supported the restoration goals of the Gulf, noting they would foster recovery of the Gulf's marine mammals. The Commission also provided to the Task Force a copy of its statement of research needs for assessing the long-term effects of the BP Deepwater Horizon oil spill on marine mammals in the Gulf of Mexico.

Early restoration activities

Coincident with the efforts of the Task Force, the Trustees approached BP to negotiate an agreement on early restoration measures. On 20 April 2011, the one year anniversary of the Deepwater Horizon explosion, the trustees and BP entered into a "Framework Agreement" that required BP and the trustees to work together to identify early restoration projects that would provide "meaningful benefits to accelerate restoration in the Gulf as quickly as practicable" and set out criteria for project design and selection.[26]

The agreement also required BP to set aside one billion dollars for early restoration projects and it outlined how the funds would be used. Each Gulf state would select and implement $100 million in projects. The federal resource trustees (NOAA and the Department of the Interior) would each select and implement $100 million in projects, with the remaining $300 million to be used for projects selected by NOAA and the Department of the Interior from proposals submitted by the states.

On 14 December 2011, the trustees announced eight early restoration projects—two each in Louisiana, Mississippi, Alabama, and Florida—that met the framework criteria. The proposed projects were selected, in part, because they were "shovel-ready" (i.e., could be implemented quickly) and soon would begin producing environmental benefits. Projects proposed for Phase I early restoration included marsh creation in Louisiana and Alabama, oyster restoration in Louisiana and Mississippi, dune restoration in Alabama and Florida, creation of artificial reef habitat in Mississippi, and boat ramp enhancement and construction in Florida. The total cost of the eight projects was estimated at $57 million, and public comment on the proposed projects was requested. The proposed projects represent only the first phase of a multi-year process. Their success will be monitored and they will be adapted as necessary.

[25] http://www.epa.gov/gcertf/pdfs/GulfCoastReport_Full_12-04_508-1.pdf

[26] http://www.gulfspillrestoration.noaa.gov/wp-content/uploads/2011/05/framework-for-early-restoration-04212011.pdf

Use of Clean Water Act penalties for restoration

Under the Oil Pollution Act of 1990, BP and the other responsible parties for the Deepwater Horizon oil spill are liable for costs associated with the removal of oil (i.e., cleanup costs) and for damages to natural resources and services caused by the spill, including the costs of assessing those damages. The Oil Pollution Act generally limits total liabilities to $75 million per spill, plus removal costs,[27] unless the responsible party for a spill showed gross negligence, willful misconduct, or a failure to comply with federal operating, construction, or safety regulations, in which case the limit does not apply (33 U.S.C. § 2704).

The responsible parties also may be subject to civil and criminal monetary penalties under the Clean Water Act, but rather than paying for clean-up or restoration of the spill in question, those penalties must be deposited into the Oil Spill Liability Trust Fund to be used for future oil spill cleanup activities. For that reason, those funds would not be available for addressing damages caused by the Deepwater Horizon spill or for restoration activities. The total amount of civil penalties that might be assessed for the Deepwater Horizon spill under the Clean Water Act would depend on findings of negligence and the calculation of barrels discharged, and could range from 5.4 to 21 billion dollars.[28] Criminal penalties under the Clean Water Act could add another two to four million dollars to that estimate.[29]

As mentioned above, the Secretary of the Navy's report recommended that the President urge Congress to use a portion of the Clean Water Act penalties for restoration and economic recovery of the Gulf. In turn, the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Oil Spill Commission) recommended in their January 2011 report to the President that 80 percent of Clean Water Act penalties be used specifically for long-term restoration of the Gulf. That recommendation has been taken up, with some variation, in legislation sponsored by various Congressional members.[30] If passed, the use of Clean Water Act penalties could foster significant progress in fully restoring the Gulf, an undertaking that the Oil Spill Commission reported could require a total of $15 to $20 billion, or $500 million annually for 30 years. Legislative options for implementing that recommendation were still under consideration at the end of 2011.

Lessons learned and actions taken to date

Congress held numerous investigations and hearings immediately after the Deepwater Horizon oil rig explosion to determine its cause. Other investigations and hearings evaluated the effectiveness of response efforts and the assessment process. All were carried out under great public scrutiny. The following summarizes some of the more prominent activities.

Congressional action: According to the Consortium for Ocean Leadership, Congress held at least 43 hearings related to the Gulf oil spill in 2010 and 20 more in 2011.[31] Congress also crafted extensive legislation—in 2010, 35 oil spill-related bills or resolutions were introduced in the House of

[27] http://www.epa.gov/osweroe1/content/lawsregs/opaover.htm

[28] The Clean Water Act provides for a civil penalty of up to $37,500 per day of violation or up to $1,100 per barrel of oil discharged. In the case of an operator's gross negligence or willful misconduct, the civil penalty becomes not less than $140,000 and not more than $4,300 per barrel of oil discharged. NOAA has estimated that approximately 4.9 million barrels of oil spilled over the course of 86 days, with approximately 800,000 barrels recovered at the wellhead.

[29] If criminal penalties are assessed, the responsible parties would be subject to a fine of between $2,500 and $25,000 per day of violation for a first violation and up to $50,000 per day for subsequent violations. For knowing violations of the Act, criminal fines range between $5,000 and $50,000 per day of violation for a first conviction, and up to $100,000 per day for subsequent violations.

[30] See www.oceanleadership.org/gulf-oil-spill/congressional-action/ for summaries of legislation introduced during the 111th and 112th Congresses pertaining to the Deepwater Horizon oil spill.

[31] http://www.oceanleadership.org/gulf-oil-spill/congressional-action/

Representatives and 19 in the Senate; in 2011, 25 bills were introduced in the House and 17 in the Senate.[32] Proposed legislation focused on a wide range of issues, among them industry liability for cleanup and damages, suspension of certain drilling activities, stronger regulation of the oil and gas industry, designation of areas that would be off limits to drilling activities, equipment to increase drilling safety, better oil spill prevention planning, reversing the drilling moratorium, enhanced research and development, and enhanced funding for the U.S. Coast Guard and NOAA.

Despite all the legislative activity, Congress passed only one bill directly responding to the Deepwater Horizon oil spill before the end of 2011. On 15 June 2010, Senate bill 3473 became Public Law 111-191, an act to amend the Oil Pollution Act of 1990 to authorize advances from the Oil Spill Liability Trust Fund for the Deepwater Horizon oil spill. In addition, two resolutions were passed in the 111th Congress, one by the Senate (S. Res. 523, 12 May 2010) and one by the House of Representatives (H. Res. 1347, 26 May 2010). Both honored the crew members who lost their lives in the Deepwater Horizon oil rig explosion and expressed condolences to their families. The House version also recognized the valiant efforts of the emergency responders at the disaster site.

Joint investigation of the explosion: On 27 April 2010, the Department of Homeland Security (Coast Guard) and the Department of the Interior (Minerals Management Service) launched a joint investigation into the explosion and sinking of the Deepwater Horizon drilling rig. The results of the investigation were issued in two volumes – the first by the Coast Guard in April 2011[33] and the second by the Bureau of Ocean Energy Management, Regulation and Enforcement in September 2011.[34]

In volume I the Joint Investigation Team determined that the explosion was ultimately caused by the loss of well control, but they also concluded that several system deficiencies and crew decisions may have contributed to the explosion or its impact, including poorly maintained electrical equipment onboard the rig, bypassing of gas alarms and automatic shutdown systems that could prevent an explosion, and lack of training of personnel on when and how to shutdown engines and disconnect the rig from the well to avoid or mitigate the damage from an explosion. The Team's initial findings pointed to a general failure of the rig's safety management system and a lack of emphasis on a "culture of safety" by the rig owners and operators.

In volume II the Bureau of Ocean Energy Management, Regulation and Enforcement's panel of investigators subsequently confirmed that the well blowout was caused proximally by a failure of a cement barrier in the production casing string—a steel pipe installed in a well to ensure well integrity and allow future production. That allowed hydrocarbons (oil and gas) to flow unimpeded up the well and onto the rig, causing the blowout. The panel attributed responsibility to BP (the operator of the rig), Transocean (the owner of the rig), Halliburton (contracted by BP to do the cementing), and Cameron (the manufacturer of the blowout preventer), and the Bureau found that BP, Transocean, and Halliburton violated several federal safety regulations. The panel recommended that stronger and more comprehensive federal regulations might have reduced the likelihood of the blowout, and included recommendations for stronger regulations to address well design, well integrity testing, kick detection and response, rig engine configuration, blowout preventers, and remotely-operated vehicles.

Department of the Interior investigations, reorganization, and new safety requirements: On 30 April 2010, the Department of the Interior established an Outer Continental Shelf Safety Advisory Board to review the Deepwater Horizon incident and to report, within 30 days, on "what, if any, additional precautions and technologies should be required to improve the safety of oil and gas exploration and production operations on the outer continental shelf." On 27 May 2010, the Department issued a report entitled "Increased Safety Measures for Energy Development on the Outer Continental Shelf."[35] The

[32] http://www.oceanleadership.org/gulf-oil-spill/congressional-action/

[33] https://homeport.uscg.mil/cgi-bin/st/portal/uscg_docs/MyCG/Editorial/20110914/2_DH%20Volume%201_redacted_3.pdf?id=eb9586805c8c65727097d3da41dd157a294b42de&user_id=2a47d4dbfd24ce2da39438e736cab2d6

[34] http://docs.lib.noaa.gov/noaa_documents/DWH_IR/reports/dwhfinal.pdf

[35] http://www.doi.gov/deepwaterhorizon/loader.cfm?csModule=security/getfile&PageID=33598

report recommended specific measures to enhance the safety of drilling operations based on preliminary findings regarding the causes of the Deepwater Horizon explosion. Recommendations called for measures to—

- ensure sufficient redundancy in the blowout preventers, including mandatory inspections, new safety features and equipment, and new testing, inspection, and reporting requirements;
- promote the integrity of the well and enhance well control through enhanced well control procedures, new requirements for casing and cement, and other features of an exploratory well; and
- facilitate a culture of safety through verification of compliance with safety requirements, new requirements to improve organizational and safety management, and development of a systems-based approach to safety and environmental management.

On 19 May 2010, Department of the Interior Secretary Ken Salazar signed a Secretarial Order to initiate the restructuring of the Minerals Management Service to split three potentially conflicting missions—energy development, enforcement, and revenue collection. The three new separate agencies were constituted as follows—

- **Bureau of Ocean Energy Management**: responsible for the sustainable development of the outer continental shelf's conventional and renewable energy resources, including resource evaluation, planning, and other activities related to leasing;
- **Bureau of Safety and Environmental Enforcement**: responsible for ensuring comprehensive oversight, safety, and environmental protection related to offshore energy activities; and
- **Office of Natural Resources Revenue**: responsible for royalty and revenue management for offshore energy leasing and development, including the collection and distribution of revenue, auditing and compliance, and asset management.

The Administration renamed the Minerals Management Service the Bureau of Ocean Energy Management, Regulation, and Enforcement in June 2010 as an interim measure while the formal reorganization was underway.

On 30 May 2010, the Department of the Interior issued a Notice to Lessees (NTL 2010-N04) announcing an immediate, six-month moratorium on drilling of all existing and new deepwater wells, and on the issuance of permits for new deepwater wells. The moratorium was intended to provide time for further investigations into the root causes of the Deepwater Horizon explosion and allow oil companies to implement new safety requirements.

To address the recommendations of the May 2010 safety report, the newly formed Bureau of Ocean Energy Management, Regulation, and Enforcement implemented several new regulations and requirements for offshore oil and gas operators. On 18 June 2010, the Bureau issued a Notice to Lessees (NTL 2010-N06) [36] requiring operators to certify compliance with existing safety regulations and with the 30 April 2010 Minerals Management Service/United States Coast Guard Safety Alert "Deepwater Horizon Explosion and Fire Resulting in Multiple Fatalities and Release of Oil." The Notice also required operators to submit information on their blowout preventer and well control system configuration for drilling rigs in use at the time the safety report was issued.

In October 2010 the Bureau issued two final safety-related rules and lifted the moratorium on deepwater drilling and permitting. The Bureau's workplace safety rule required oil and gas companies to implement safety and environmental management systems for all activities conducted on the outer continental shelf (75 Fed. Reg. 63610). That rule had been proposed earlier (in June 2009) by the Minerals Management Service, and the Marine Mammal Commission had commented in support of the rule in a letter dated 15 September 2009.

[36] http://www.boem.gov/Regulations/Notices-To-Lessees/2010/10-n06.aspx

That same month, the Bureau also issued an interim final rule to amend drilling regulations related to well control, including requirements for subsea and surface blowout preventers, well casing and cementing, secondary intervention, unplanned disconnects, recordkeeping, well completion, and well plugging (75 Fed. Reg. 63346). The Marine Mammal Commission commented in support of the rule on 13 December 2010, and recommended that in addition to imposing the new regulations, the Bureau conduct a systematic review and risk assessment of each offshore oil and gas operation and identify additional safety measures needed to address shortcomings in all aspects of operations. The Commission also recommended that the Bureau devise and implement new and creative techniques for promoting, tracking, and enforcing compliance with safety measures and regulations, including incorporation of non-regulatory incentives for compliance. Finally, the Commission recommended that the Bureau establish apprenticeships, internships, training programs, partnerships with academia and industry, and/or international exchange programs to recruit, train, and maintain the highly skilled workforce needed to oversee the offshore oil and gas industry, enforce regulations, and ensure strict adherence to safety measures and procedures.

In November 2010, the Bureau issued a Notice to Lessees requiring that companies verify compliance with regulations requiring demonstration of adequate spill response and well containment resources (NTL 2010-N10). In June 2011 the Bureau announced that it would begin deploying multi-person inspection teams for offshore oil and gas inspections rather than single inspectors. The Bureau also established an Ocean Energy Safety Advisory Committee in April 2011 (which met twice) and also embarked on an intensive recruitment campaign for inspectors, engineers, and environmental scientists.

On 1 October 2011, the the Assistant Secretary for Policy, Management, and Budget assumed the duties of the Office of Natural Resources Revenue and the Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement split the remaining responsibilities of the former Bureau of Ocean Energy Management, Regulation, and Enforcement. Both of the new Bureaus were kept under the Assistant Secretary for Land and Minerals Management.

At the end of 2011, the Bureau of Safety and Environmental Enforcement had not revised the former Bureau's interim final drilling rule, but many of its other safety reforms have addressed the Commission's concerns regarding industry safety practices and have strengthened enforcement of safety requirements. The Bureau of Safety and Environmental Enforcement implemented internal reforms, such as a recusal policy for employees with real and perceived conflicts of interest, the establishment of special teams to implement recommendations from external review bodies, and a new investigations and review unit to respond to allegations or evidence of misconduct and unethical behavior by the Bureau's employees and/or industry. The new safety and enforcement measures implemented by the Bureau will require an adaptive approach to ensure that regulations and requirements for oil and gas operators keep pace with advancing technologies for drilling and promote advancements in well containment and spill response.

Oil Spill Commission investigation and recommendations: As noted earlier, on 21 May 2010, the President established the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (Oil Spill Commission). He directed the Commission to examine, within six months, the relevant facts and circumstances concerning the root causes of the Deepwater Horizon oil disaster, and to develop options for guarding against, and mitigating the impact of, oil spills associated with offshore drilling, taking into consideration the environmental, public health, and economic effects of such options. The Commission, co-chaired by Senator Bob Graham and former Environmental Protection Agency Administrator William K. Reilly, held six public meetings between July and December 2010. The Marine Mammal Commission provided extensive comments and recommendations for consideration by the Oil Spill Commission in a letter dated 1 November 2010.

In its 2011 final report, the Oil Spill Commission concluded that the Deepwater Horizon explosion was caused by a loss of well control, also known as a blowout, and that it could have been prevented (Oil Spill Commission 2011). The lack of an adequate risk management system by the operators of the well was symptomatic of failures in the safety culture of the industry as a whole, especially with respect to the challenges inherent in deepwater oil and gas exploration. The Oil Spill Commission concluded that fundamental reform was needed of the regulatory oversight process, as well as self-policing by the

industry. The spill revealed the inadequacy of current spill containment, response, and cleanup capabilities, and shortcomings in our scientific understanding of the environmental conditions in deepwater and other frontier environments (i.e., the Arctic).

The Oil Spill Commission made numerous recommendations to—

- improve the government's role in ensuring the safety of offshore operations;
- improve the industry's role in ensuring the safety of offshore operations;
- safeguard the environment;
- strengthen oil spill response, planning, and capacity;
- advance well-containment capabilities;
- overcome the impacts of the Deepwater Horizon spill and restoring the Gulf;
- ensure financial responsibility;
- promote Congressional engagement to ensure awareness of the risks of offshore drilling; and
- prepare for the expansion of oil and gas development into frontier areas.

In its report, the Oil Spill Commission recommended that government work with industry to develop a stronger safety culture including more rigorous risk management systems. It also recommended the development of international standards for drilling, production, and emergency response, and a pro-active, risk-based performance approach specific to individual facilities, operations, and environments. To address conflicts within the Minerals Management Service, it recommended the establishment of an independent agency within the Department of the Interior with oversight of drilling safety, consistent with the Department's ongoing reorganization of the Minerals Management Service and the creation of the independent Bureau of Safety and Environmental Enforcement. It also recommended that Congress provide adequate funding to the regulatory agencies for reviewing and permitting drilling and development activities. The Oil Spill Commission did not make specific recommendations regarding the number, training, qualifications, and practices of government regulators, as recommended by the Marine Mammal Commission, but it did recommend enhancement of government expertise and industry planning to ensure adequate well control and spill containment.

The Oil Spill Commission also recommended the establishment of a private organization to ensure continuous improvements in safety and operational integrity by developing, adopting, and enforcing industry standards of excellence. Such standards could include testing of equipment and technology, as recommended by the Marine Mammal Commission. The Marine Mammal Commission called for a national database of oil and gas operations. The Oil Spill Commission did not go that far, but it did call for requirements for industry reporting and data concerning offshore incidents and "near misses" to allow for better tracking of incidents and stronger risk assessments and analysis.

The Oil Spill Commission reviewed the National Environmental Policy Act process in place prior to the Deepwater Horizon explosion and concluded that it needed significant revision. Specifically, the Oil Spill Commission noted the Department of Interior's over-reliance on "tiering" as a substitute for detailed site-specific reviews, the routine application of categorical exclusions to potentially risky or harmful activities (i.e., deepwater drilling), the practice of area-wide leasing, and the lack of formal guidance for conducting National Environmental Policy Act reviews. The Oil Spill Commission recommended that the Department of the Interior revise and strengthen National Environmental Policy Act policies, practices, and procedures to improve its environmental analyses, transparency, and consistency at all stages of the leasing, exploration, and development process. It also called for greater interagency consultation (especially with NOAA) on oil and gas decision-making processes, the formation of a joint research program to address data gaps, regular independent reviews of the government's environmental studies programs, industry protocols for data collection, and industry fees to support the environmental science and regulatory review process. Although the Oil Spill Commission did not make specific recommendations regarding the quality and quantity of baseline population and health information for marine mammals and marine wildlife, the recommendations regarding enhanced environmental research

would help to address the Marine Mammal Commission's call for information standards to ensure that the environmental review process is not only transparent and accessible but also adequately informed.

The Deepwater Horizon was an important reminder of the inadequacy of oil spill response capabilities and the Marine Mammal Commission noted in its 1 November 2010 letter that the lack of preparation for addressing problems could and should have been anticipated by the oil and gas industry and government regulators. The Oil Spill Commission apparently agreed, recommending that the Department of the Interior create a rigorous, transparent, and meaningful oil spill risk analysis and planning process. It also recommended that the Environmental Protection Agency and the Coast Guard establish distinct plans and procedures for responding to a "spill of national significance," bolster state and local involvement in contingency planning and training, and create a mechanism for local involvement in spill planning and response. It concluded that Congress should provide mandatory funding for oil spill response research and development and should also create incentives for the private sector to make similar investments. The Oil Spill Commission also recommended that dispersants be tested and pre-approved and that the use of offshore barrier berms be prohibited.

The Oil Spill Commission also made several recommendations for overcoming the impacts of the spill and restoring the Gulf. In particular, the Commission recommended that independent scientists be given timely access to the response area to facilitate research and long-term monitoring. The Commission noted that a clear commitment to independent science would bolster public confidence and trust and enhance understanding of a spill's effects on wildlife and the marine ecosystem. The Oil Spill Commission also recommended that compensatory restoration under the natural resource damage assessment process be transparent and appropriate, that Clean Water Act penalties be used for long-term restoration, and that federal agencies balance economic and environmental interests for restoration of the Gulf through improved monitoring systems (such as the Gulf of Mexico Integrated Ocean Observing System) and the use of coastal and marine spatial planning tools.

The Oil Spill Commission report concluded with several recommendations regarding human health impacts, financial responsibility and liability of the responsible parties, revisions to payout limits of the Oil Spill Liability Trust Fund, and Congressional engagement and awareness of the risk of offshore drilling and moving oil and gas exploration to frontier regions. Regarding the latter, the Oil Spill Commission cautioned that increasing demands for domestic oil production have led to increased pressure to develop higher risk sources of oil, such as those found in the ultra-deepwater environments of the Gulf and the largely untapped reserves of the Arctic Ocean. It noted that the Arctic presents several challenges due to its remoteness, harsh conditions, and lack of infrastructure, trained personnel, and equipment to respond to an oil spill emergency. The Oil Spill Commission recommended an immediate, comprehensive, and coordinated federal research effort to provide scientific information needed for informed decision-making in the Arctic. It noted that Alaska native people, dependent on the marine environment for subsistence, must be actively involved in planning and response. The Oil Spill Commission recommended that (1) the Department of the Interior ensure that oil spill containment and response plans are adequate for each stage of development and satisfactorily tested in the Arctic, (2) the Coast Guard and industry carefully delineate and prepare for their respective responsibilities in the event of an accident, and (3) Congress provide the resources to establish Coast Guard capabilities in the Arctic. Finally, the Oil Spill Commission recommended that strong international standards be developed for oil and gas development throughout the Arctic.

Implementation of the Oil Spill Commission's recommendations has been hindered by partisan disagreement regarding the proper pace of oil and gas development on the outer continental shelf and concerns that a precautionary approach to drilling could affect economic recovery in the Gulf. However, some progress has been made. Following the release of the Oil Spill Commission's report, H.R. 501 was introduced in the House of Representatives and called for implementation of the recommendations of the Oil Spill Commission. Other bills were introduced to implement selected recommendations. None of those bills had passed by the end of 2011, but the Department of the Interior, NOAA, and industry had begun implementing some of the Oil Spill Commission's recommendations, including the reorganization of the Minerals Management Service into three independent agencies, the signing of a Memorandum of

Agreement between the Bureau of Ocean Energy Management, Regulation and Enforcement and NOAA on 19 May 2011 regarding scientific information used to support decision-making regarding oil and gas development,[37] and the development of a joint government-industry data sharing agreement for Arctic research signed 19 August 2011 by NOAA, Shell, ConocoPhillips, and StatOil.[38]

National Academy of Sciences: Early in 2011 the National Academy of Sciences Ocean Studies Board began a study of the Deepwater Horizon oil spill effects on the Gulf's ecosystem services. The study aimed to create "a framework to assist federal agencies in assessing the effects of the oil spill on ecosystem services within the context of other human activities."[39] The Academy planned to release its report early in 2012. Once completed the study is supposed to address the following questions—

- What methods are available for identifying and quantifying various ecosystem services, at spatial and temporal scales conducive to research, that provide meaningful information for the public and decision-makers?
- What kinds of valuation studies and metrics are appropriate to measure the recovery of ecosystem services over time with regard to each of the following: natural processes, mitigation, and restoration efforts? What baseline measures are available that would provide benchmarks for recovery and restoration efforts?
- Is there sufficient pre-spill baseline information available to separate oil spill impacts from impacts of other human activities? What methods are available to help distinguish impacts specific to the spill?
- What ecosystem services (provisioning, supporting, regulating, and cultural services) were provided in the Gulf of Mexico Large Marine Ecosystem prior to the oil spill? How do those differ among the subregions of the Gulf of Mexico?
- How did the spill affect each of those services in the short-term, and what is known about potential long-term impacts given the other stresses, such as coastal wetland loss, on the Gulf ecosystem?
- How do spill response technologies (e.g., dispersant use, coastal berm construction, absorbent booms, in situ burning) affect ecosystem services, taking into account the relative effectiveness of those techniques in removing or reducing the impacts of spilled oil?
- In light of the multiple stresses on the Gulf of Mexico ecosystem, what practical approaches can managers take to restore and increase the resiliency of ecosystem services to future events such as the Deepwater Horizon Mississippi Canyon 252 spill? How can the increase in ecosystem resiliency be measured?
- What long term research activities and observational systems are needed to understand, monitor, and value trends and variations in ecosystem services and to allow the calculation of indices to compare with benchmark levels as recovery goals for ecosystem services in the Gulf of Mexico?

Next steps

At its May 2011 annual meeting, the Marine Mammal Commission focused on efforts to respond to the BP Deepwater Horizon oil spill and to assess short- and long-term spill effects on the Gulf's marine mammals. The Commission heard presentations from federal and state agencies, non-governmental organizations, private researchers, and regional stranding network members regarding their role in the spill response and assessment, preliminary findings, and next steps. From those presentations, the Commission developed the following recommendations, which were directed primarily at NOAA as the lead federal agency for response, assessment, and restoration planning for marine mammals.

[37] http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Partnerships/MOU_BOEMRE_NOAA_May2011.aspx
[38] http://alaskafisheries.noaa.gov/sustainablefisheries/arctic/arcticmoa081911.pdf
[39] http://dels.nas.edu/Study-In-Progress/Effects-Deepwater-Horizon-Mississippi/DELS-OSB-10-02#

Balancing scientific and legal considerations: After the spill some controversy developed regarding the relationship between scientific and legal objectives in the assessment of the spill's effects. That relationship has become an issue in efforts to assess damages, assign economic values to lost services, and develop strategies for restoration and long-term monitoring of the Gulf. It also is relevant to the government's approach to oil and gas development in high-risk areas, such as the Arctic.

The controversy involved two related, but separate goals: (1) providing a science-based understanding of the effects of spilled oil and response activities on the marine ecosystem, and (2) gathering evidence for future legal proceedings regarding the cause of the spill and the nature and extent of damage. Many spill responders relayed to the Commission that they were required to work at the interface of science and law, and often the boundaries were not clear to them. The interplay between science and law also was confusing to many scientists outside the assessment process and to the public, especially regarding authorities, responsibilities, and priorities in the face of the calamity.

Science and law are both endeavors that seek to determine the truth—but they do so in somewhat different ways. By their nature, legal proceedings are adversarial, with each side of an issue shaping the facts to create a more compelling case. A number of legal proceedings are following or will follow the spill and, for the most part, they are or will be aimed at assessing responsibility for the spill and its adverse effects. Science, on the other hand, is not necessarily adversarial, but rather a means of collecting and sharing information for all to examine and use for describing a particular phenomenon or answering a particular question. In this case, the major questions were how to stop the spill and what were or will be its short- and long-term effects.

Scientists often found themselves at the center of the controversy. For example, some scientists (both federal and private) participating in spill response and assessment were uncertain about what data and samples could be collected and analyzed and what results shared. During much of the spill and response, many were under the impression that scientific efforts were unnecessarily constrained by legal concerns and that research opportunities were unnecessarily lost. The Commission does not have a sufficient basis for evaluating the merits of those concerns, but thinks they warrant follow-up.

At least four things might have contributed to the confusion. First, rumors always abound during such an event and require some time to sort, investigate, and either verify or dispel. Second, the agencies and organizations involved in the response and assessment have different roles and objectives, and those objectives may not have been clearly integrated and prioritized. Third, even within a single agency, objectives and information may not have been transferred effectively up and down the agency's organizational structure. And fourth, in a case such as the Deepwater Horizon, law and science simply may not be completely compatible.

Such matters are not easily reviewed during a spill when decisions must be made regarding both response and assessment and actions must be carried out expeditiously. Rather, they might be best reviewed after an event when problems are still fresh in people's minds and before their attention is redirected toward other concerns. Although the trustees were still actively engaged in assessment at the end of 2011, the Commission thought it important to review response and assessment efforts sooner rather than later. Important lessons may be lost if not evaluated, summarized, and recorded for future planning and reference. Our nation's ever growing demand for oil and gas resources increases not only the number of operations over the outer continental shelf, but also the risk of another major spill, not only in the Gulf but in other vulnerable areas such as the Arctic. It would be unfortunate to be faced with another spill of substantial magnitude in the near future, but especially so if agencies have not evaluated and corrected any shortcomings evident in their response to the Gulf spill and the assessment of its effects.

With all those concerns in mind, the Marine Mammal Commission recommended in a 14 October 2011 letter that NOAA, as the primary trustee with responsibilities for both marine mammal response and assessment, develop and implement a strategy to (1) review its actions during the course of the Gulf spill response and assessment, (2) clarify its legal and scientific objectives and the relationship between them, (3) characterize the lessons learned from the spill that should be incorporated into future response and

assessment plans, and (4) characterize its capacity for responding to, and assessing the effects of, future spills, especially those that may occur in the Arctic.

Updating contingency plans and response guidelines: In its letter to NOAA, the Commission stated that the results of such a review would be useful in updating national and regional contingency plans and oil spill response guidelines, which have been developed by multiple agencies in accordance with various laws, regulations, and directives. In the Gulf, response to oiled wildlife is covered generally in two regional contingency plans that do not include specific references to marine mammals. The plans designate the Fish and Wildlife Service as the lead agency for responding to endangered species and they charge NOAA with responsibility for the "living marine resources it manages and protects."[40] During the Gulf spill, the lack of specificity in the plans resulted in confusion within the Unified Command regarding NOAA's authority and responsibilities for marine mammals, sea turtles, and other protected species. NOAA officials were not always notified immediately in situations requiring Endangered Species Act consultations or the development of best management practices for activities affecting those species. An in-depth review of NOAA's response to the spill could help the agency clarify its responsibilities and authority in updated contingency plans. That review also could help clarify response authority and procedures specific to marine mammals, as outlined in NOAA's Marine Mammal Oil Spill Response Guidelines (Johnson and Ziccardi 2006).

Reckoning with the baseline problem: The *Exxon Valdez* oil spill illustrated the importance of good baseline information (Loughlin 1994, Matkin et al. 2008). More than two decades later, that lesson has not been heeded. The responsible agencies cannot provide a full accounting of the Deepwater Horizon spill's effects on wildlife, even for many of the Gulf's largest and most charismatic fauna, because they lack baseline information. Such information is adequate for only a handful of the Gulf's 57 marine mammal stocks (Waring et al. 2010).

In the Commission's view, the lack of baseline information is indicative of larger problems with our national research and management strategy in the Gulf of Mexico and our failure to meet the goal of managing marine ecosystems based on a strong scientific foundation. Management of the Gulf ecosystem cannot be considered science-based if the responsible agencies do not collect and analyze the data needed to guide management. Despite the fact that the Gulf is the base for industries generating billions of dollars annually, NOAA—our premier marine science agency—lacks the necessary infrastructure, equipment, and personnel to characterize the ecosystem, monitor industrial activities, and assess their impacts. In essence, our commitment to sound science as a basis for management does not match our willingness to exploit the Gulf's resources at some peril to its marine ecosystem.

With that concern in mind, the Marine Mammal Commission recommended in its 14 October 2011 letter that NOAA incorporate in its review of the Gulf spill (1) a careful and in-depth analysis of the factors that have precluded the collection of scientific baseline information adequate for managing the Gulf's marine mammals and marine resources, and (2) the steps necessary to address those factors.

Evaluating the natural resource damage assessment process: The natural resource damage assessment process is intended to establish the basis for compensating for spill effects. NOAA hosted one public meeting of scientific experts to identify potential spill effects on marine mammals and sea turtles, but subsequent meetings were limited to natural resource trustees and members of the Marine Mammal and Sea Turtle Technical Working Group. In its 14 October 2011 letter, the Commission recommended that, as part of its review, NOAA should evaluate how well that group functioned and whether it provided adequate guidance for assessing effects on marine mammals and sea turtles. The idea of an independent review of the group's work is consistent with scientific traditions and experience. In reviewing lessons learned from the *Exxon Valdez* spill, Hofman (1994) cited the need for early establishment of an independent peer review process to help identify critical research needs. Although it may not be possible to incorporate independent scientists directly into the damage assessment process, it is not too late to evaluate the Marine Mammal and Sea Turtle Technical Working Group and make recommendations for improving the work of such groups.

[40] http://www.nrt.org

Assessment of long-term effects: The natural resource damage assessments for marine mammals may be completed years before the effects of the Deepwater Horizon oil spill are fully realized. Long-term wildlife studies following the *Exxon Valdez* spill have revealed chronic, delayed, and indirect effects that were longer and more severe than expected or assumed (Peterson et al. 2003). Exposure to oil from that spill was still impeding recovery of certain sea otter and whale populations 15 years later (Ballachey et al. 2007, Matkin et al. 2008). The Deepwater Horizon oil spill differs in some important respects from the *Exxon Valdez* spill, but long-term effects remain a concern for Gulf marine mammals because of the amount of oil spilled, the quantity of dispersants applied at the surface and wellhead, the low recovery rates of spilled oil, uncertainty regarding the eventual disposition of both oil and dispersants, and uncertainty regarding the effects of the spill and spill response on ecosystem elements important to marine mammals.

As noted above, the Marine Mammal Commission drafted the report "Assessing the Long-term Effects of the BP Deepwater Horizon Oil Spill on Marine Mammals in the Gulf of Mexico: A Statement of Research Needs" to address uncertainty about the long-term effects of the Gulf spill. The Commission recommended that NOAA identify its highest priorities for assessing long-term spill effects on marine mammals, using the Commission's report as a guide.

Because the natural resource damage assessment process may be completed before the long-term spill effects are known, it may be necessary to re-open the damage assessment process to investigate evidence of unanticipated effects. For example, hundreds of dolphins stranded in the nearshore waters of the northern Gulf immediately before, during, and after the spill, and should long-term studies indicate that the spill has been a contributing factor, NOAA should be able to re-open the damage assessment process as needed to seek appropriate compensation. The Marine Mammal Commission recommended that NOAA work with the Bureau of Ocean Energy Management and other federal and state agencies and funding entities as appropriate to ensure the necessary long-term monitoring studies are conducted.

Standards for environmental information: The National Environmental Policy Act requires the Bureau of Ocean Energy Management to evaluate alternatives for resource development based, in part, on their anticipated environmental effects. In addition, the Marine Mammal Protection Act requires the Bureau to manage energy development to ensure that it has no more than negligible effects on marine mammals. In the Commission's view, anticipating and managing such potential effects should be science-based and should include, among other things, a thorough understanding of pre-development baseline conditions.

Despite decades of offshore oil and gas production in the Gulf, the Bureau, NOAA, and the oil and gas industry have yet to collect adequate information to determine if and how oil and gas production is affecting marine mammal species and stocks. Such information includes stock structure, distribution, abundance, movement patterns, age structure, demography (age structure, vital rates), and health (e.g., nutritional status, immune function, and exposure to contaminants, biotoxins, and pathogens). The Bureau has funded studies of marine mammals in the Gulf but they fall far short of what is needed for environmentally sound energy development. The Bureau's Studies Development Plan for Fiscal Year 2012–2014 does not include plans to address those deficiencies.[41]

On several occasions the Commission has recommended to the Bureau that it develop standards for baseline environmental information on marine mammals that may be affected by energy-related activities. To do so, the Bureau should collaborate with the federal agencies that have management and oversight responsibilities for marine mammals—NOAA, the Fish and Wildlife Service, and the Marine Mammal Commission. The Oil Spill Commission highlighted the importance of such interagency consultation in their "Deep Water" report. Consistent with the Oil Spill Commission's findings, the Marine Mammal Commission recommended in 2011 that the Bureau work with the above-named agencies to develop comprehensive standards for baseline information needed to evaluate the effects of offshore oil and gas operations on marine mammals and their habitat. The Commission offered its help to facilitate the development of such standards, and to meet with Bureau staff regarding next steps.

[41] http://www.boem.gov/uploadedFiles/2012-2014_Studies_Development_Plan.pdf

Analysis of marine mammal samples: After the spill, the Commission developed two seemingly opposing concerns. The first was that a desire for rapid natural resource damage assessment and associated compensation might circumvent a full assessment of damages and thereby lead to an incomplete restoration effort. Such an outcome could occur if sample collection and analysis were terminated before the expression of potential long-term effects. Such effects might occur if exposure occurred relatively slowly, or if animals were exposed and re-exposed over long periods to oil re-entering the water column during storms (for example). In the Commission's view, long-term studies are needed to ensure that this is not the case.

The seemingly opposing concern was that samples were not being analyzed expeditiously after the spill, leading to apprehension that exposure levels and consequences might be poorly described. In this regard, one of the key components of assessment is determination of whether marine mammals were exposed to various contaminants, such as polycyclic aromatic hydrocarbons and dispersants, during the spill and response. At the Commission's 2011 annual meeting, speakers informed the Commission that samples collected from marine mammals during and after the spill had yet to be analyzed for such contaminants. The Commission's understanding was that even at the end of 2011, more than a year-and-a-half after the spill, the trustees still had not approved a cooperative workplan for conducting the needed analyses.

The Commission understood that the delay reflected, in part, uncertainty regarding the best analytical methods for detecting certain types of contaminants. To address that concern, NOAA has been working with various agencies to evaluate the most appropriate tissue types for analyses and to conduct pilot studies to determine the feasibility of measuring polycyclic aromatic hydrocarbons and/or biomarkers. If some of the potential contaminants cannot be reliably detected in marine mammal tissues due to rapid elimination, then alternative methods for assessing exposure should be developed. Based on its concerns the Marine Mammal Commission recommended that NOAA continue to work with the National Institute of Environmental Health Sciences, Centers for Disease Control and Prevention, National Institute of Science and Technology, Environmental Protection Agency, Bureau of Ocean Energy Management, and other federal agencies and independent laboratories as appropriate to develop and standardize laboratory analytical methods to detect, quantify, and determine the toxicity of polycyclic aromatic hydrocarbons and dispersants in marine mammals and other marine wildlife. In addition, the Commission recommended that, if the parties responsible for the Deepwater Horizon spill would not support pertinent sample analyses, then NOAA should fully fund and expedite the analysis of such samples from stranded or live-captured marine mammals for evidence of exposure and persistence of polycyclic aromatic hydrocarbons and dispersants; and, as appropriate, include the results of the analyses in the natural resource damage assessment of the spill's effects. Even if those analyses do not contribute to the natural resource damage assessment, the scientific knowledge gained from the research would promote more effective responses to future spills.

Determining whether marine mammals were affected by the contaminants from the spill and/or response is important not only for the purpose of determining spill and response effects, but also for investigating the large die-off of bottlenose dolphins in the northern Gulf. Although that die-off began before the spill, it has been prolonged and severe, and none of the information analyzed to date is sufficient to rule out the spill and response actions as contributing factors. At the end of 2011, the National Marine Fisheries Service, working in coordination with the Working Group on Marine Mammal Unusual Mortality Events, was investigating the strandings and having tissue samples analyzed for various contaminants, biotoxins, and infectious agents (e.g., *Brucella*, morbillivirus) that have been associated with or suspected as causes of previous unusual mortality events in the northern Gulf. Results were not yet available at the end of 2011.

Restoration planning for marine mammals: The purpose of a natural resource damage assessment is to determine what restoration actions are necessary to return injured natural resources and services to baseline conditions and to compensate for interim losses to make the environment and public whole (15 C.F.R. § 990.30). For the most part, restoration for marine mammals will depend largely on actions taken to promote the recovery of a healthy Gulf ecosystem (i.e., one relatively free of oil and other spill-

contaminants; with suitable habitat for reproduction, resting, foraging; and with suitable diversity and abundance or biomass of prey). The lack of baseline information, as described above, effectively precludes an unambiguous determination of when such restoration is complete for marine mammals. Absent such information, scientists cannot characterize the full effects of the spill or determine when those effects have been alleviated. The only way to overcome that impediment to sound management is to develop a strategy for adequate stock assessment and long-term monitoring of the health of Gulf marine mammals. For that reason, the Commission believes that restoration activities must be integrated with stock assessment efforts and health assessments to provide managers with the best possible information on recovery from the spill. To that end, the Marine Mammal Commission recommended that NOAA develop a restoration plan for the Gulf that ensures not only thorough clean-up of the spilled oil, but also basic assessment of the Gulf's marine mammal stocks and the factors affecting their status.

Offshore Oil and Gas Development

A synopsis of offshore oil and gas development in the United States: 1896–2006

The first drilling for oil in ocean waters took place in 1896 off the coast of California (Minerals Management Service 2007). It involved a platform connected to land by a pier and, although the yield was modest, it proved that oil could be extracted from beneath the ocean floor. That effort set the stage for drilling offshore—a challenging but lucrative environment for exploiting oil and gas resources. Since then, offshore drilling has pushed the limits of technology and innovation, with the deepest wells now being drilled in waters more than 2,900 m deep in the Gulf of Mexico.[42]

Oil rigs have evolved over time from simple fixed platforms in coastal waters to submersible, mobile platforms that are more conducive to drilling in deeper waters far from shore (Figure III-8). Exploration increased offshore after World War II, when increasing demand to fuel automobiles and heat homes drove advancements in drilling technology (Penney 2008). U.S. oil companies made use of wartime technologies and equipment to exploit offshore oil and gas reserves, primarily in the Gulf of Mexico where resources were plentiful (Penney 2008).

Prior to 1953, individual states had issued leases for oil production in all offshore waters. The Submerged Lands Act and the Outer Continental Shelf Lands Act were both passed in 1953 to clarify state-federal jurisdiction over offshore oil and gas resources. The Submerged Lands Act reaffirmed the

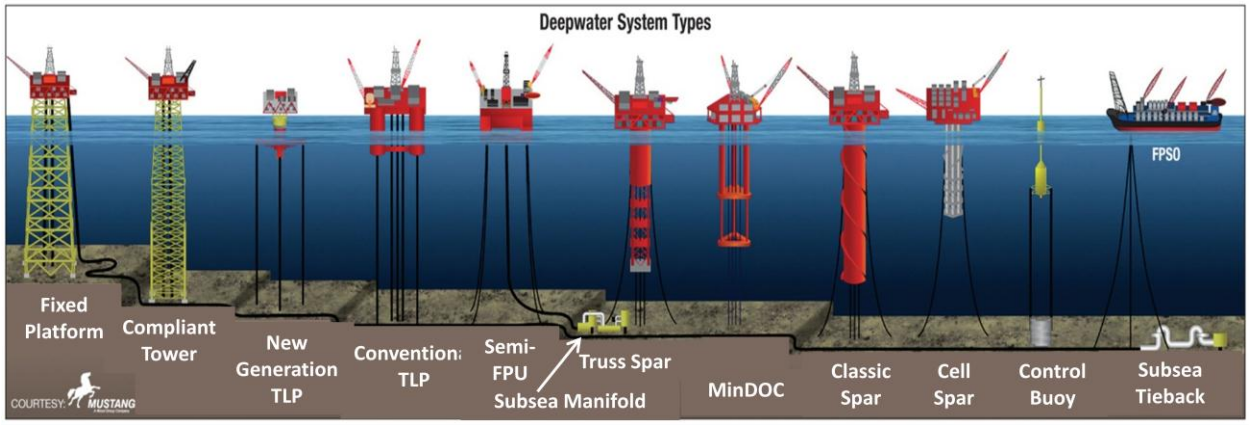

Figure III-8. Types of deepwater oil drilling rigs. (With permission from 2011 Deepwater Solutions for Concept Selection poster, Wood Group Mustang and Offshore Magazine)

[42] http://www.bsee.gov/Exploration-and-Production/Development-and-Production/Gulf/Gulf-of-Mexico-Deepwater-Information.aspx

states' authority to grant leasing rights within the boundaries of state waters, generally three miles from the coast.[43] The Outer Continental Shelf Lands Act gave the Department of the Interior jurisdiction over all offshore lands beyond state waters. The first federal lease sale was held in 1954 by the Department's Bureau of Land Management, but disputes over state's rights stalled leasing for several years (Priest 2008). The demand for leases was so great that when the Bureau resumed leasing in 1962, the sale earned the government $445 million in cash bonuses for a record two million acres leased (Priest 2008, Oil Spill Commission 2011). Most of the demand was in the Gulf of Mexico—production from Gulf resources reached nearly 10 percent of the U.S. total oil and gas production by 1970.[44]

As oil companies ventured into increasingly distant offshore waters in the Gulf and elsewhere, they took increasingly larger risks to extract and transport oil and gas resources cheaply and quickly. Offshore drilling required expensive rigs and skilled labor, yet oil prices were not keeping pace with expenses. Regulatory oversight and enforcement of offshore drilling in the U.S. was limited by the oil and gas industry and by understaffed and inexperienced regulators at the federal and state level (Oil Spill Commission 2011). The blowout of a Union Oil well in the Santa Barbara Channel in 1969 prompted a moratorium on offshore drilling and a complete overhaul of drilling regulations by the Department of the Interior. It also set the stage for passage of the National Environmental Policy Act and other laws in the 1970s to better address impacts from oil and gas development and oil spills (Clarke and Hemphill 2002, Kolbert 2010, Morgan 1994). The industry initially pushed back on new regulations, but a series of blowouts and fatal accidents in the early 1970s led to a concerted effort by regulators and industry to impose considerable new safety and training requirements for offshore drilling, both in the U.S. and around the world. As a result, the number of catastrophic accidents and associated fatalities decreased despite a steady push to drill in deeper and deeper waters (Oil Spill Commission 2011).

In the mid to late 1970s the increasing demand for oil and a 1973 embargo on foreign oil by the Organization of the Petroleum Exporting Countries (OPEC) again prompted more leasing and development of oil reserves. Many new oil and gas reserves were being discovered along the continental shelf edge in the Gulf of Mexico and their exploitation was hastened by new and increasingly cheaper technologies designed for drilling in deep water (defined as water depths between 200 m and 1,500 m,

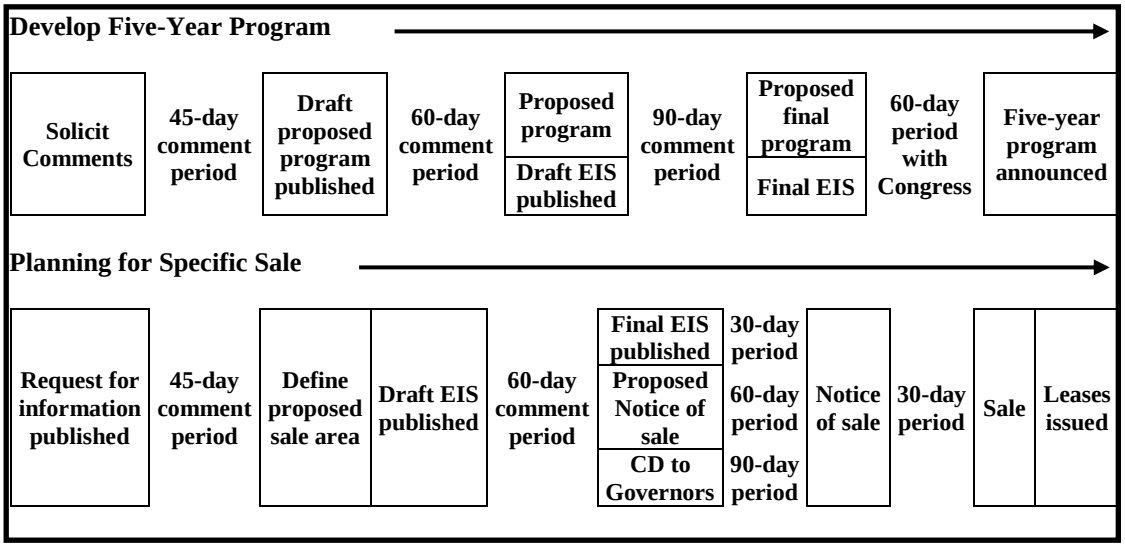

Figure III-9. The steps involved in planning, leasing, exploration, and development of oil and gas resources, under the Outer Continental Shelf Lands Act (Bureau of Ocean Energy Management)

[43] The state waters boundary for leasing off Texas and the west coast of Florida was set at three leagues, or 10.4 miles (16.7 km), based on historical claims.
[44] http://www.data.bsee.gov/homepg/data_center/production/production.asp

Bureau of Ocean Energy Management 2011a). Some regions of the U.S. expanded their leasing and development efforts, but others did not. In fact, concerns regarding the environmental impact of oil and gas development led at least one California environmental group to call for a halt to offshore lease sales.[45]

The Outer Continental Shelf Lands Act, as originally written, directed the Secretary of Interior to issue leases "for the prevention of waste and conservation of natural resources." However, the concern at the time was more about conserving oil and gas resources than about conserving the natural environment from which those resources were extracted. In 1978 political reaction to expanded leasing and development without adequate consideration of effects on coastal resources or input from coastal states led lawmakers to amend the Act. The 1978 amendments were intended to promote "expeditious and orderly development" of oil and gas reserves while protecting the environment and the interests of the coastal states (President Jimmy Carter 1978). The amendments also—

(1) made it easier for small and medium-sized energy firms to compete in the bidding process for leases;
(2) established a tax on oil revenues to be placed in the Offshore Oil Spill Pollution Compensation Fund to provide for damages caused by oil spills, and a Fishermen's Contingency Fund to compensate fishermen for damaged fishing gear associated with oil and gas exploration;
(3) directed the Secretary to prepare periodic (five-year) leasing programs that incorporate National Environmental Policy Act reviews at each stage of the leasing process, and ensure greater consideration of input by state and local agencies on the timing, size, and location of proposed lease sales and on proposed development and production plans (Figure III-9); and
(4) established an environmental studies program within the Department.

The Minerals Management Service was established in 1982 and consolidated functions that previously had been split between the Bureau of Land Management's Outer Continental Shelf Program and the U.S. Geological Survey Conservation Program. The formation of the new agency was spearheaded by James Watt, Secretary of the Department of the Interior under President Ronald Reagan, with the intent of creating a more efficient leasing program. Under Secretary Watt's direction, the Minerals Management Service began the practice of area-wide leasing, making available for leasing all unleased blocks within a planning area, rather than only those blocks nominated and selected for leasing. That practice helped spur new development in the Gulf, especially in deep-water environments in which the industry had limited interest (Oil Spill Commission 2011).

Attitudes towards offshore drilling were mixed in different coastal regions. Western coastal states were vocal in their opposition to oil and gas development, leading Congress to impose a moratorium on new offshore oil and gas leasing off the U.S. West Coast in 1982. Soon after that, Congress included the mid-Atlantic and the eastern Gulf of Mexico in the moratorium. Leasing continued in the central and western portions of the Gulf of Mexico and also in Alaska, despite some opposition in those areas. Nearshore wells in Cook Inlet and the Kenai Peninsula had been producing commercial quantities of oil and gas for years, and the discovery of a massive oil field in Prudhoe Bay on the North Slope of Alaska in 1967 seeded hopes of discovering additional offshore reserves in the Alaska region, especially in Arctic areas adjacent to Prudhoe Bay. Oil companies drilled 95 exploratory and test wells on the Alaska outer continental shelf between 1975 and 1993 (Figures III-10 and III-11).[46] Most of the wells were either dry or deemed not commercially productive, with the exception of the Northstar oil pool in the Beaufort Sea, which was discovered in 1984 and went into production in 2001.

In March 1989 the *Exxon Valdez* oil tanker ran aground, spilling about 11 million gallons of crude oil into Prince William Sound. The oil spread over 1,100 miles of non-continuous coastline extending to the Gulf of Alaska and the Alaska Peninsula. The spill raised significant concerns about the adequacy of existing oil spill prevention and response capabilities. Before the end of that year Congress banned all drilling in Bristol Bay, Alaska, and in August 1990 it passed the Oil Pollution Act by unanimous vote.

[45] http://www.getoilout.org
[46] http://www.boem.gov

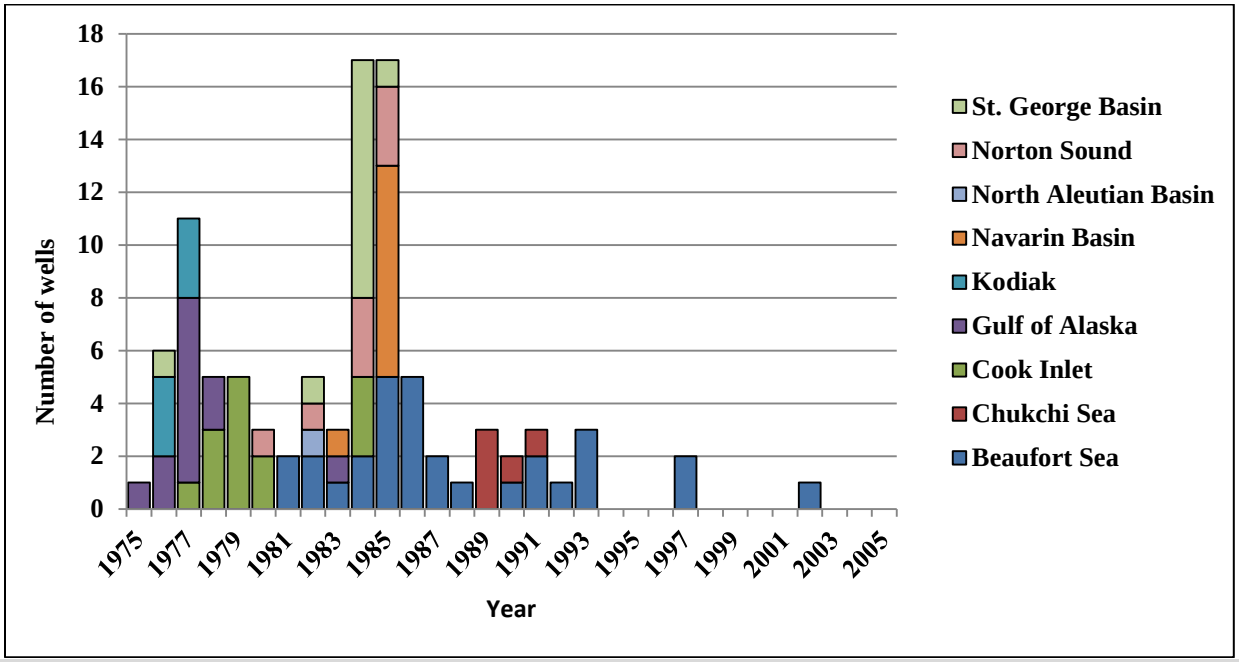

Figure III-10. Exploratory and deep stratigraphic test wells drilled in the Alaska outer continental shelf region, by planning area and year. (Bureau of Ocean Energy Management)

The Oil Pollution Act was designed to (1) help prevent future oil spills, and if spills did occur, (2) provide quick and efficient response and clean-up, (3) minimize damage to fisheries, wildlife, and other natural resources, (4) provide adequate compensation for victims of oil spills, and (5) assign costs for such efforts to the parties responsible for the spill. Among other things, the Act—

- required all oil tankers operating in U.S. waters to be constructed or retrofitted with stronger, double hulls;
- required the development of contingency plans, thereby ensuring an organized and coordinated response effort when spills occurred;
- increased penalties that could be levied for failing to report a discharge;
- assigned liability to the parties responsible for oil spills and other discharge events but also placed limitations on that liability, based on vessel or facility type (elr.info/legislative/federal-laws/oil-pollution-act, Morgan 1994);
- authorized the funding of the Oil Spill Liability Trust Fund and the use of the Fund for oil spill removal costs, natural resource damage assessments, restoration activities, and administrative costs; Sources of funds included transfers from other existing funds, penalties under various pollution-related statutes, per-barrel excise taxes on industry for oil produced or imported, and recovery of costs from the responsible parties for oil spill removal, damage assessment, and restoration activities;[47] and
- established an oil pollution and research program, to be administered by the U.S. Coast Guard.[48]

The reactions to the *Exxon Valdez* oil spill, including the Oil Pollution Act, had substantial implications for oil imports as well as exploration and production activities. Several oil companies

[47] http://www.uscg.mil/npfc/About_NPFC/osltf.asp
[48] http://www.iccopr.uscg.gov/

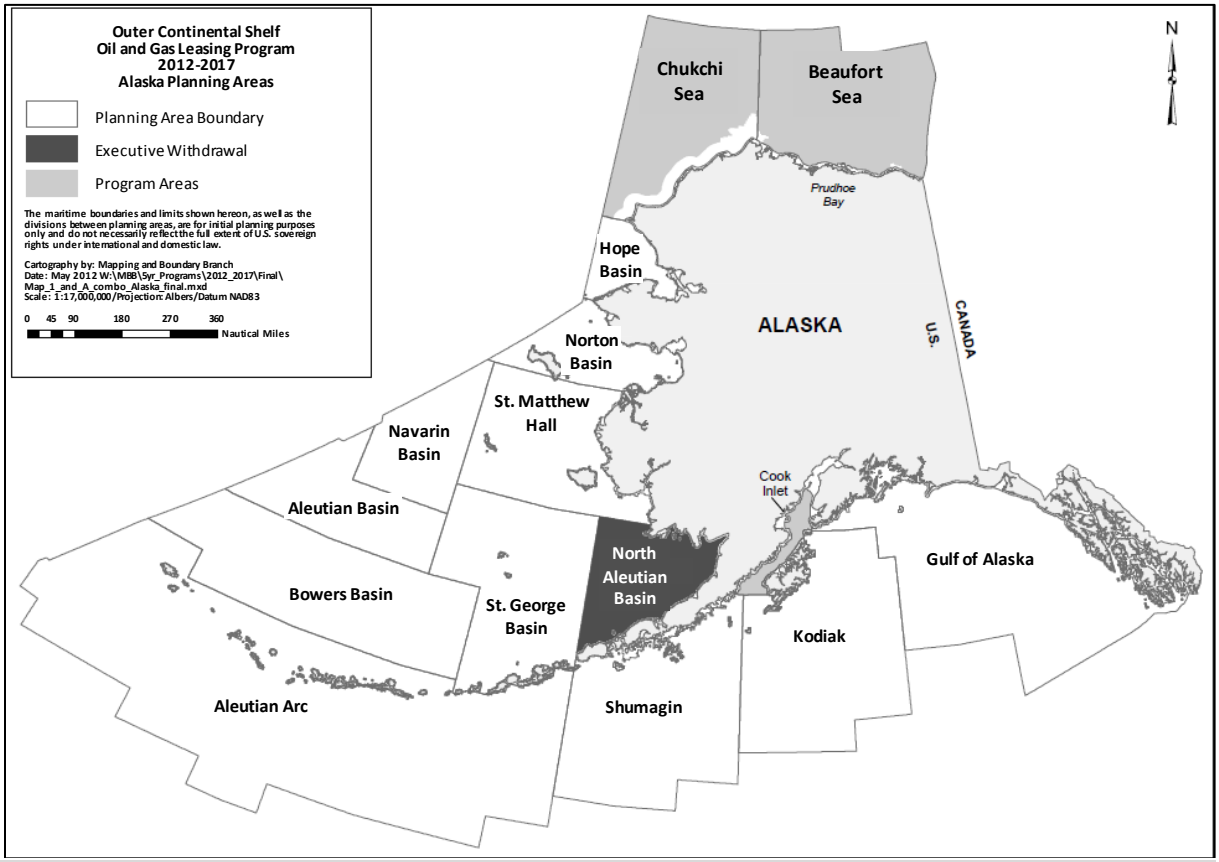

Figure III-11. Alaska outer continental shelf planning areas. (Bureau of Ocean Energy Management)

responded to the new requirements for vessel construction and demonstration of financial responsibility by threatening to stop all shipments of oil into the United States. Others reorganized to protect their parent companies from potential claims against their shipping subsidiaries (Morgan 1994). Nonetheless, over time, oil shipments to the U.S. remained steady, vessel safety improved and spill rates decreased.

The effects of the *Exxon Valdez* oil spill on exploration and production activities varied by region. High operating costs, low oil prices, and less than expected returns caused oil companies to abandon exploration activities in the Arctic by the mid 1990s. The Bristol Bay drilling ban further dampened interest in exploratory drilling in Alaska waters. For a short period of time production in the Gulf of Mexico also dropped off immediately after the spill because of a new executive moratorium on oil and gas leasing in the eastern Gulf,[49] and because oil companies moved their operations to foreign waters to avoid the financial requirements of the Oil Pollution Act.[50] However, production quickly rebounded and the central and western Gulf of Mexico remained an active area for leasing, exploration, and production throughout the 1990s. Advances in computing power and seismic technology, especially 3-D seismic and wide-azimuth technology (see below), led to the discovery and exploitation of previously untapped oil and gas reserves in the Gulf's shallow waters and new reserves in its deep (200–1,500m) and ultra-deep waters (>1,500 m). The new technology allowed geologists to pinpoint the location of "subsalt plays"—substantial petroleum reserves hidden under the massive salt bodies unique to the Gulf region. With a long-term view toward development, oil companies consolidated their resources and expertise and began

[49] President George H.W. Bush's 1990 executive moratorium also included oil and gas leasing in the offshore waters of the Pacific and the Atlantic.
[50] http://www.data.bsee.gov/homepg/data_center/production/production/summary.asp, Morgan 1994

amassing significant holdings in the Gulf, despite the technological difficulties associated with extracting oil from increasingly challenging environments.

Rising gas prices and concerns about energy security prompted Congress to pass the Energy Policy Act of 2005 and the Gulf of Mexico Energy Security Act of 2006. The Energy Policy Act aimed to reduce U.S. dependence on foreign oil and develop new sources of energy, including renewable energy, clean coal, and nuclear energy. It also provided tax incentives and royalty relief to encourage further oil and gas development in the Gulf of Mexico. The Gulf of Mexico Energy Security Act stipulated, in part, (1) leasing of certain portions of the central and eastern Gulf, (2) sharing of oil lease revenues with four Gulf coastal states (Texas, Louisiana, Mississippi, and Alabama) for coastal restoration and protection projects, and (3) banning oil and gas leasing within 125 miles off the Florida coast in the eastern planning area and a portion of the central planning area within 100 miles of the Florida coast until 2022.

As directed by the Energy Policy Act, the Department of the Interior prepared a report to Congress with a comprehensive inventory of oil and gas resources in the U.S. outer continental shelf (Minerals Management Service 2006). The report provided estimates of both known and undiscovered resources in each of the U.S. outer continental shelf planning areas. The report highlighted the importance of the Gulf of Mexico as the nation's leading source of known reserves and undiscovered resources. It also indicated relatively large undiscovered but technically recoverable resources in Alaska, primarily in the Chukchi and Beaufort Seas. The Bureau revised the assessment in 2011 and it shows the same general trends (Table III-4).

Regulatory framework for oil and gas development

The Outer Continental Shelf Lands Act, as amended, provides the statutory framework for oil and gas development on the outer continental shelf. The Act's goals, as identified by the Bureau (Matthews and Cameron 2010), are to—

- expedite exploration and development of the outer continental shelf to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade;

Table III-4. Technically recoverable oil and gas resources on the outer continental shelf, 2011[51]

Region	Known resources			Undiscovered resources (mean estimate)	Total endowment (mean estimate)
	Cumulative production	Reserves	Reserves appreciation		
Oil (billion barrels)					
Alaska	0.01	0.03	0.00	26.61	26.65
Atlantic	0.00	0.00	0.00	3.30	3.30
Gulf of Mexico	15.96	9.25	9.52	48.40	83.13
Pacific	1.21	1.52	0.00	10.20	12.93
Total	**17.18**	**10.80**	**9.52**	**88.59**	**126.01**
Natural gas (trillion cubic feet)					
Alaska	0.00	0.00	0.00	131.45	131.45
Atlantic	0.00	0.00	0.00	31.28	31.28
Gulf of Mexico	171.82	22.85	48.47	219.46	462.60
Pacific	1.62	1.26	0.00	16.10	18.98
Total	**173.44**	**24.11**	**48.47**	**398.37**	**644.31**

[51] http://www.boem.gov/Oil-and-Gas-Energy-Program/Resource-Evaluation/Resource-Assessment/2011_National_Assessment_Factsheet-pdf.aspx

- preserve, protect, and develop oil and natural gas resources of the outer continental shelf in a manner that is consistent with the need to—
  - make such resources available to meet the nation's energy needs as rapidly as possible;
  - balance orderly resource development with protection of the human, marine, and coastal environments;
  - ensure the public a fair and equitable return on the resources of the outer continental shelf; and
  - preserve and maintain free enterprise competition; and
- encourage development of new and improved technology for energy resource production, which will eliminate or minimize the risk of damage to human, marine, and coastal environments.

The Act outlines a four-stage process for oil and gas development (Figure III-9). The first stage involves the preparation of a five-year leasing program that identifies the size, timing, and location of proposed lease sales that will best meet the nation's energy needs for the next five-year period. The leasing program must consider the "economic, social, and environmental values of the renewable and nonrenewable resources contained on the outer continental shelf, and the potential impact of oil and gas exploration on other resource values of the outer continental shelf and the marine, coastal, and human environments." To that end, the Bureau of Ocean Energy Management (formerly the Minerals Management Service) analyzes the environmental impact of proposed lease sales in accordance with the Outer Continental Shelf Lands Act and the National Environmental Policy Act. Outer continental shelf areas must be included in the five year program analysis in order for the Bureau to conduct lease sales in those areas. The Bureau may later cancel or delay any of the sales in the five year program, but cannot add sales in new areas without developing a new program and conducting analysis for those areas.

During the second stage, the Bureau plans for and conducts the individual lease sales specified in the five year program. It issues a call for information, further delineates the lease sale area, and conducts a site-specific environmental analysis. The lease sale is then conducted through a sealed-bid process and the Bureau determines whether the bids meet the fair market value criteria. If so, the lease is issued.

The third stage involves exploration and requires the lessee to submit an exploration plan outlining all planned activities for a specific lease(s), the timing of the activities, information concerning drilling vessels, the location of each well, and an analysis of both offshore and onshore impacts that may occur as a result of the plan's implementation. The Bureau must then decide whether a supplemental environmental review is required under the National Environmental Policy Act. It makes that determination based on whether the proposed activities fall within the range of actions described in an established categorical exclusion, or whether extraordinary circumstances exist that warrant additional review.[52] If approved, the lessee is responsible for obtaining any additional permits that may be required for exploration, including an incidental take authorization under the Marine Mammal Protection Act if exploration activities may impact marine mammals.

The fourth and final stage of the process is approval of a development and production plan, referred to in the Gulf of Mexico as a Development Operations Coordination Document. Again, the Bureau must review the lessee's plan and determine whether a supplemental environmental review is required and whether the plan is in compliance with other federal laws and regulations.[53] If the development plan is approved, the lessee is responsible for obtaining the required permits before it begins proposed activities.

[52] Extraordinary circumstances are defined by Department of Interior regulations implementing the National Environmental Policy Act at 43 CFR Part 46.215, and include activities that have "highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks."

[53] Some of the federal laws that lessees/operators must comply with throughout the development process include the National Environmental Policy Act of 1970, the Clean Air Act of 1970, the Coastal Zone Management Act of 1972, the Clean Water Act of 1977, the Federal Oil and Gas Royalty Management Act of 1982, the Marine Mammal Protection Act of 1972, and the Endangered Species Act of 1973.

Oil and gas leasing and development activities, 2007 to present

The first stage of oil and gas development involves the drafting and approval of a five-year leasing program, also known as the five-year program. The five-year program is the schedule of lease sales, by date and area, during the stipulated five year period. There are three "drafts" of the program schedule and supporting analysis: the draft proposed program, the proposed program, and the final proposed program. Following the announcement of the final proposed program, the Secretary must notify the President and Congress and wait 60 days before approving and adopting the schedule of proposed leases as the five-year program. The Bureau also prepares a programmatic environmental impact statement to accompany the five-year program. The final programmatic environmental impact statement is approved coincident with the announcement of the final proposed program documents.

The 2007–2012 and 2012–2017 leasing programs: The 2007–2012 five-year program approved by President Bush's Administration included 21 lease sales.[54] The then Minerals Management Service conducted lease sale 193 (Chukchi Sea) in February 2008. That sale was carried over from the previous five-year program and was the first in the Chukchi Sea since 1991. The sale was conducted despite litigation by the Native Village of Point Hope, the Center for Biological Diversity, the Alaska Wilderness League, and Pacific Environment over perceived inadequacies in the environmental impact statement.[55] Interest in the sale was greater than anticipated, drawing record offers on 487 leases and collecting bids worth about $2.7 billion on more than 2.7 million acres.

In July 2008 increasing concern about escalating fuel prices and the call for expanded drilling opportunities led President George W. Bush to lift his father's 1990 presidential moratorium on offshore drilling. Shortly afterward, under threat of a presidential veto if a similar longstanding Congressional moratorium on offshore oil and oil shale leasing were included in the fiscal year 2009 annual appropriations bill, Congress allowed the leasing moratorium to expire.

In January 2009 President Bush proposed a new five-year program for the period from 2010 to 2015 to increase access to energy resources. The draft proposed program included two additional lease sales in the mid-Atlantic planning area, leasing in what are referred to as the North and South Atlantic planning areas, and leasing off southern and northern California (Figure III-12). It also added an additional lease sale in the North Aleutian Basin of Alaska and evaluated expanded lease sales in the eastern and central Gulf of Mexico in the event that moratoriums implemented under the Gulf of Mexico Energy Security Act were lifted. Of the 31 sales proposed, 10 were in areas that, prior to 2008, were under executive and/or congressional restrictions. The draft proposed program also reiterated the Administration's commitment to the development of alternative energy sources, particularly offshore wind energy.

After taking office in January 2009, President Obama's Administration first extended the comment period on the 2010–2015 draft proposed program and then replaced it with a preliminary revised program to complete the 2007–2012 period (75 Fed. Reg. 16833). The 2007-2012 preliminary revised program eliminated all planned or proposed lease sales in the Pacific, North Atlantic, South Atlantic, North Aleutian Basin, Beaufort Sea, Chukchi Sea, and eastern Gulf of Mexico (except areas mandated for leasing under the Gulf of Mexico Energy Security Act). It retained lease sales in Cook Inlet, the mid-

[54] The Five Year OCS Oil and Gas Leasing Program for 2007-2012, approved in June 2007, included lease sales in Alaska (Beaufort Sea, Chukchi Sea, Cook Inlet, and North Aleutian Basin), the Pacific, the Gulf of Mexico (Western, Central, and Eastern), and the Atlantic.

[55] The U.S. District Court for the District of Alaska issued an Order on 21 July 2010 remanding lease sale 193 to what was then the Bureau of Ocean Energy Management, Regulation, and Enforcement, forcing the Bureau to satisfy its obligations under the National Environmental Policy Act to address three concerns: (1) the environmental impact of natural gas development; (2) whether information missing from the environmental impact statement for lease sale 193 was essential or relevant under 40 CFR § 1502.22; and (3) whether the cost of obtaining the missing information was exorbitant, or the means of doing so unknown. The Bureau issued a final supplemental environmental impact statement in August 2011 and the District Court lifted the injunction against permitting of exploratory drilling in the Chukchi Sea lease sale area on 26 October 2011.

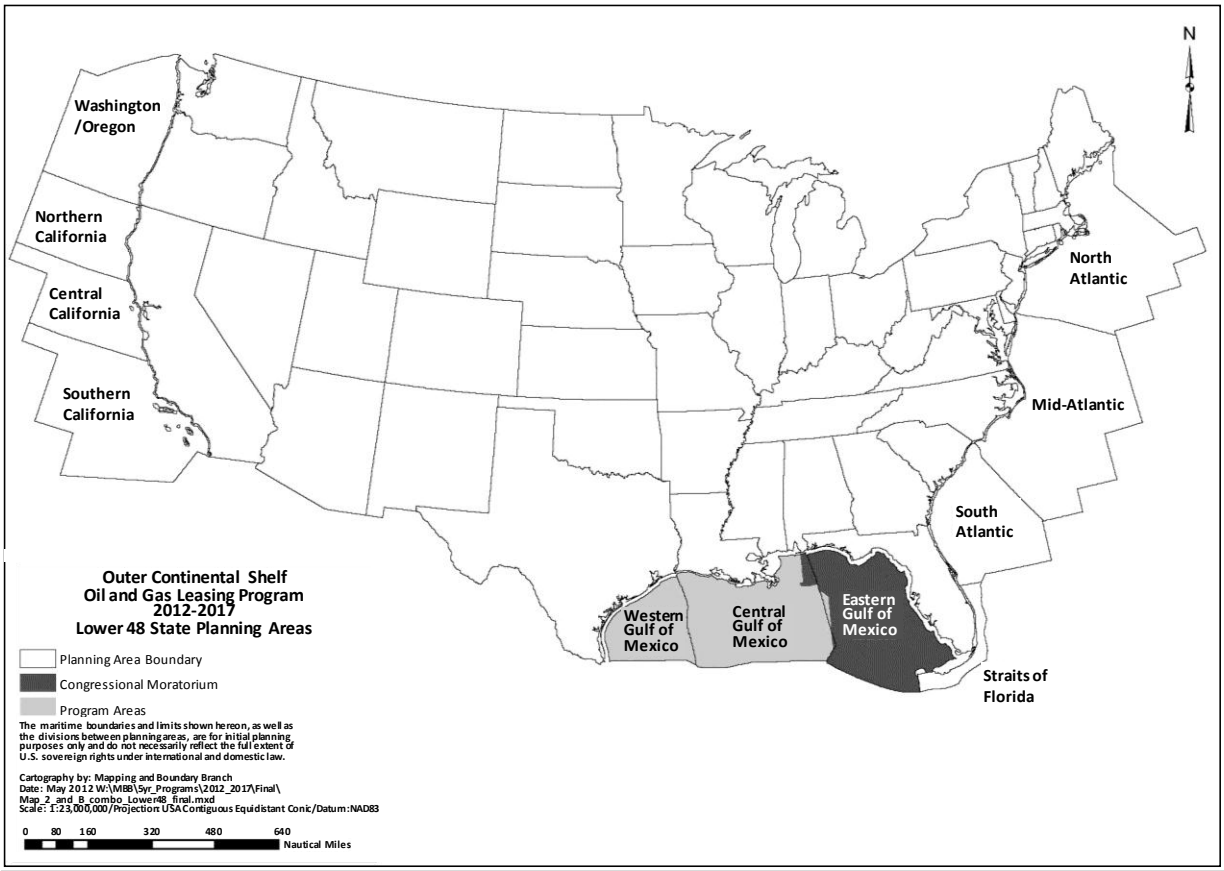

Figure III-12. Outer Continental Shelf Oil and Gas Leasing Program 2012-2017, lower 48 state planning areas (Source: BOEM)

Atlantic, the central and western Gulf of Mexico, and a mandated lease sale in the eastern Gulf of Mexico. Reaction to the preliminary revised program was mixed, with proponents supporting lease sales in the Atlantic, Cook Inlet, and the Gulf of Mexico as a path toward energy security, and opponents objecting to the inclusion of military training areas off Virginia and Cook Inlet, the latter being important for conserving the endangered Cook Inlet beluga whale.

The Deepwater Horizon exploded in the Gulf within weeks of the Obama Administration's announcement of the 2007-2012 preliminary revised program, bringing all leasing and deepwater drilling activities to a halt. Shortly thereafter the Administration reorganized the Minerals Management Service as the Bureau of Ocean Energy Management, Regulation, and Enforcement. Almost immediately, the newly formed Bureau cancelled its scheduled lease sales in the mid-Atlantic and western Gulf of Mexico to allow time to "develop and implement measures to improve the safety of oil and gas development in federal waters, provide greater environmental protection, and substantially reduce the risk of catastrophic events" (75 Fed. Reg. 44276). As noted in the previous section, in May 2010 BOEMRE also implemented an immediate, six-month moratorium on drilling of all existing and new deepwater wells and on the issuance of permits for new deepwater wells. Lessees and operators were required to certify their compliance with existing safety regulations and safety alerts and to submit information on their blowout preventers and the configurations of their well control systems for drilling rigs. The Secretary of the Interior lifted the moratorium in October 2010 after BOEMRE had verified the required compliance certifications and imposed new safety measures for workplace and drilling safety.

The Bureau then resumed leasing and permitting activities, issuing its final revised five-year program for 2007–2012 in December 2010. The 2007-2012 five-year program retained the remaining

lease sale in the western Gulf of Mexico and consolidated the two remaining lease sales in the central Gulf. Exclusions of lease sales in the North Aleutian Basin, Atlantic, and Pacific were extended through 2017. In February 2011, under heightened scrutiny, the Bureau resumed issuance of new deepwater drilling permits. It also developed a supplemental environmental impact statement for the remaining lease sale in the western Gulf and the consolidated lease sale in the central Gulf. The western Gulf lease sale was conducted in December 2011, and the consolidated central Gulf lease sale, the last lease sale in the five-year program, was scheduled for 2012. The Marine Mammal Commission submitted comments on the draft supplemental environmental impact statement for remaining lease sales in the Gulf of Mexico under the 2007–2012 five-year program, recommending that the Bureau develop a set of standards for baseline information needed to assess the effects of oil and gas operations, consider ways to improve oil spill prevention and response capabilities, and prepare for public review the lessons learned and adjustments made as a result of the Deepwater Horizon oil spill to improve management of offshore oil and gas operations.

The 2012–2017 five-year program: In April 2010, just prior to the Deepwater Horizon oil spill, the former Minerals Management Service began scoping for the 2012–2017 Five Year Program. It developed its draft proposed program based, in part, on comments received on the draft proposed program for 2010–2015 and comments received on its notice of intent to scope and prepare an environmental impact statement for the 2012–2017 five-year program (75 Fed. Reg. 16828). On 30 June 2010, the Marine Mammal Commission commented on the notice of intent, recommending that the Minerals Management Service include in its environmental impact statement a clear, detailed, and systematic description of the phases of oil and gas production and the infrastructure or equipment involved, that it develop a set of standards for baseline information to be obtained prior to the initiation of new energy-related operations, that it include a more detailed description of the data and methods used in its ecosystem sensitivity analysis, and that it use the environmental consequences section of the environmental impact statement to integrate all of the information in the preceding sections and systematically describe the risks associated with each phase of oil and gas development/production and each component of the related infrastructure, including support operations.

In November 2011, the Bureau of Ocean Energy Management announced its 2012-2017 proposed program with 15 proposed lease sales. The proposed program included two lease sales in the eastern Gulf of Mexico, annual area-wide lease sales in the central and western Gulf of Mexico, one lease sale each for the Beaufort and Chukchi Sea, and a special lease sale in Cook Inlet. Despite Congressional pressure, the Bureau did not include lease sales for the North Aleutian Basin, Atlantic, or Pacific. However, the Bureau confirmed plans to conduct a programmatic environmental impact statement on geological and geophysical (including seismic) surveys in the Mid- and South-Atlantic planning areas. The surveys would be used by industry and the Bureau to update available geological and geophysical data in some areas and acquire first time data in others to determine the resource potential of oil and gas and renewable energy development and marine mineral resource potential in those areas. In June 2012, the Bureau announced the final proposed program and programmatic environmental impact statement for the 2012-2017 five-year program. The final proposed program retained the 15 lease sales from the proposed program. Final approval of the 2012-2017 five-year program is expected in 2012.

Categorical exclusions for offshore drilling: Prior to 2010, the Minerals Management Service routinely issued categorical exclusions for exploration and development plans in the Gulf of Mexico, including deepwater wells. However, in August 2010 the Council on Environmental Quality issued a report reviewing the Service's National Environmental Policy Act policies, practices, and procedures as they relate to outer continental shelf oil and gas exploration and development. The Council used the Deepwater Horizon oil spill as a case study of the Service's approach to complying with the Act.[56] In its

[56] The Council on Environmental Quality had recently proposed guidance on the use of categorical exclusions government-wide (18 February 2010), and many of the recommendations in the Council's August 2010 "Report regarding the Minerals Management Service's National Environmental Policy Act policies, practices, and

report, the Council recommended that the Bureau review its use of categorical exclusions for oil and gas operations "in light of the increasing levels of complexity and risk—and the consequent potential environmental impacts—associated with deepwater drilling." The Bureau issued a memo in response to the Council's report stating that it would limit its use of categorical exclusions for offshore oil and gas development while it undertakes a comprehensive review of its National Environmental Policy Act process and the use of categorical exclusions.[57]

In October 2010 the Bureau announced its intent to conduct such a review and requested public comments (75 Fed. Reg. 62418). The Marine Mammal Commission commented on specific categories of actions for which categorical exclusions had been issued, and recommended that the Bureau discontinue the use of categorical exclusions for exploration, development, and production plans in the Gulf. The Commission further recommended that the Bureau review its requirements for safety and environmental management systems and its practices for inspecting those systems to ensure that they are functioning as designed and expected. The Commission also expressed concern that oil and gas operators in the Gulf of Mexico generally do not apply for and obtain incidental take authorizations under the Marine Mammal Protection Act for their operations. To provide a more accurate assessment of the direct and indirect effects of oil and gas operations on marine mammals and other marine resources in the Gulf of Mexico, the Commission recommended that the Bureau work with the National Marine Fisheries Service and the Fish and Wildlife Service to expedite implementation of the incidental take provisions of the Marine Mammal Protection Act in the Gulf, including enhanced information collection and analysis requirements. At the end of 2011, the Bureau had yet to issue a notice regarding the outcome of their review.

Seismic surveys: The advancement of 3D seismic acquisition technology, and more specifically, 3D wide azimuth technology, has significantly increased the success rate of wells drilled in the Gulf of Mexico, up from a 30 percent success rate in 1990 to 60 percent in 2010 (U.S. Energy Information Administration 2010). Those activities introduce sound into the water that can disturb or even injure marine mammals or interfere with their ability to hear important, natural sounds. Section 101(a)(5)(A-D) of the Marine Mammal Protection Act provides a mechanism for authorizing the "incidental," but not intentional, take of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region provided the takings would be (1) small in number, (2) have no more than a negligible impact on marine mammals, and (3) have no unmitigable adverse impact on subsistence harvests of those species. Survey operators can apply for an authorization to take marine mammals by Level A (injury) or Level B (harassment).[58]

Despite some progress, the National Marine Fisheries Service has yet to evaluate fully the impact of seismic survey activities in the Gulf of Mexico or to prescribe mitigation and monitoring requirements that would ensure that seismic activities are having no more than a negligible impact on Gulf marine mammal species and stocks. The lack of analysis is inconsistent with the requirements of the Marine Mammal Protection Act and is particularly disconcerting given the spatial and temporal extent of seismic activity in the Gulf. In 2002 the former Minerals Management Service petitioned the National Marine Fisheries Service for rulemaking under section 101(a)(5)(A) of the Marine Mammal Protection Act to authorize any potential take of sperm whales incidental to conducting seismic surveys during oil and gas exploration activities in the Gulf of Mexico (68 Fed. Reg. 9991). The National Marine Fisheries Service

procedures as they relate to Outer Continental Shelf oil and gas exploration and development," pertained to the Minerals Management Service's use of categorical exclusion in approving exploration and construction plans.

[57] Memo from Bureau of Ocean Energy Management, Regulation, and Enforcement Director Michael Bromwich, dated 16 August 2010, on the use of categorical exclusions in the Gulf of Mexico region (http://www.doi.gov/news/pressreleases/upload/GOM-memo.pdf).

[58] Under the Marine Mammal Protection Act, take means to "harass, hunt, capture, or kill, attempt to harass, hunt, capture, or kill any marine mammal." The term "Level A harassment" means any action which "has the potential to injure a marine mammal or marine mammal stock in the wild." "Level B harassment" means any action that "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

subsequently issued a notice of intent to prepare an environmental impact statement for the requested authorization (69 Fed. Reg. 67535), but an environmental impact statement was never published. In April 2011, the Bureau of Ocean Energy, Management, and Enforcement submitted a revised application to the National Marine Fisheries Service to take small numbers of cetaceans incidental to oil- and gas-related seismic and other geophysical surveys in the Gulf (76 Fed. Reg. 34656). The National Marine Fisheries Service and the Bureau of Ocean Energy Management were in the process of developing a joint programmatic environmental impact statement at the end of 2011.

The Marine Mammal Commission commented on the Bureau's 2011application, seeking clarification as to whether Level A takes were requested, or whether takes would be limited to Level B harassment. The Commission recommended that Level A and B harassment zones be identified in the proposed rule based on acoustic modeling and/or empirical data and, if based on modeling, should be updated after in-situ measurements for all sound sources were made and estimated sound pressure levels verified. The Commission recommended that the National Marine Fisheries Service require that the Bureau's mitigation measures apply to all marine mammals, not just those listed as threatened or endangered under the Endangered Species Act, and that passive acoustic monitoring be used to collect data on the occurrence, abundance, distribution, and movement of marine mammals during periods before, during, and after all of the proposed activities. The Commission also recommended that the National Marine Fisheries Service advise the Bureau of the need to work jointly with industry operators to consider, and potentially fund, the testing of new technologies (i.e., unmanned aerial or underwater vehicles) for use in far-field monitoring.

In contrast to the management approach used in the Gulf of Mexico, the National Marine Fisheries Service routinely evaluates the impact of seismic surveys in Alaska and prescribes mitigation and monitoring measures as appropriate. The Commission comments on those authorizations (or applications for them) and generally recommends issuance of the authorizations as long as they require the mitigation and monitoring measures needed to ensure the Act's requirements are met. However, in 2011, the Service issued notice of receipt of an application from Apache Alaska Corporation for a 3D seismic survey in Cook Inlet (76 Fed. Reg. 58473). In that case, the Marine Mammal Commission recommended that the Service defer issuance of the proposed incidental harassment authorization until such time as the Service can, with reasonable confidence, support a conclusion that the proposed activities would have no more than a negligible impact on the Cook Inlet beluga whale population. The Commission further recommended that in the event the Service issued the authorization, the applicant be required to re-estimate the harassment zones and the number of expected takes to account for the simultaneous, alternating use of two sound sources and the overlap of their acoustic footprints, and the full number of expected survey days. The Commission recommended also that the Service require the applicant to seek authorization to take the full number of marine mammals that, in fact, may be taken and to ensure that the monitoring measures included in the authorization are sufficient to account for all takes of marine mammals.

Exploratory and production drilling: Considerable drilling activities occur routinely in the Gulf of Mexico, but neither the industry nor the Bureau of Ocean Energy Management has received authorization from the National Marine Fisheries Service and under the Marine Mammal Protection Act for takes of marine mammals incidental to drilling activities. In contrast, all takes of marine mammals incidental to drilling activities in Alaska are subject to review by the National Marine Fisheries Service and the Service requires appropriate mitigation and monitoring measures to be implemented as a condition of issuance of incidental harassment authorizations.

Plans to drill exploratory wells in the Alaskan Arctic were delayed in 2010 and 2011 as the Bureau responded to ongoing litigation over lease sale 193 and concerns about the adequacy of oil spill response capabilities after the Deepwater Horizon oil spill. In December 2010 the Marine Mammal Commission submitted comments on the draft supplemental environmental impact statement for lease sale 193, recommending, among other things, that the Bureau adopt a slow, phased approach to oil and gas development in the Chukchi Sea. Oil companies also worked during that timeframe to implement the new safety standards for drilling operations and address concerns about the effects of an oil spill in icy waters.

In November 2011, the National Marine Fisheries Service published two notices announcing the receipt of applications from Shell Offshore, Inc., for incidental harassment authorizations associated with planned exploratory drilling in the Beaufort and Chukchi Seas during the 2012 open water season (July to October). In December 2011, the Marine Mammal Commission submitted comments on both applications, raising concerns about the noise levels associated with the drilling rigs and the ability to fully monitor the proposed harassment zones. The Commission recommended that the Service require negotiation of conflict avoidance agreements between Shell and the Alaska Eskimo Whaling Commission and the bowhead whale hunters it represents. The Commission also recommended that Shell develop and implement detailed, comprehensive, and coordinated wildlife management plans to minimize contamination of sensitive marine habitats and to respond to marine mammals in the event of an oil spill. To reduce the possibility of having to respond to a large oil spill in ice conditions, the Commission recommended that the Service require Shell to cease drilling operations in mid- to late-September in both areas. Finally, the Commission recommended that Shell be required to collect all new and used drilling muds and cuttings in the Chukchi Sea, as was required in the Beaufort Sea, and either inject them below the seafloor or transport them to a treatment/disposal site outside the Arctic and licensed by the Environmental Protection Agency.

Stages of oil and gas development and key risk factors for marine mammals

The National Environmental Policy Act and associated regulations require agencies to evaluate the potential effects of major federal actions on the human environment. To do so, agencies must describe and analyze the affected environment (including its physical, biological, and ecological aspects); the nature of the proposed action and supporting activities; the individual and cumulative risks associated with the proposed and related actions; and the measures to prevent, minimize, mitigate, or otherwise respond to those risks. Analyses of cumulative effects must take into account other human activities in the proposed action area. To be comprehensive, those analyses should include the expected physical, biological, ecological, and human-related effects of climate disruption.

Oil and gas development in the marine environment proceeds in stages that roughly parallel the regulatory process outlined in the Outer Continental Shelf Lands Act. The following is a description of the activities that occur at each stage of oil and gas development and a brief summary of the associated risks to marine mammals and potential environmental effects on the marine ecosystem (see also Table III-5). Also included is a brief summary of the potential effects of oil spills and leaks.

Exploration: Exploration for oil and gas is the process of searching for and characterizing hydrocarbon reserves. The exploration stage involves acoustic surveys, gravity and magnetic surveys, sediment sampling, exploratory drilling, and temporary capping and abandonment of the well. In the ocean as on land, petroleum geologists and geophysicists may use visual cues and other geological information to locate natural seeps, faults, or other features within sub-surface sediments that may contain hydrocarbon reserves.[59] Seismic surveys in the ocean use a controlled sound source, such as an airgun, to transmit sound waves to the ocean floor. The sound waves are then reflected back to a hydrophone or other listening device. The pattern of reflected waves can indicate boundaries between different types of sediments and other subsurface geologic features, particularly traps or pockets that could indicate the presence of hydrocarbons. Seismic surveys can vary in sound intensity and frequency and in the amount of geographic area covered, and the types of surveys used are dependent on site-specific considerations, such as the depth of the water, the depth of the geologic features of interest, and whether there are pre-existing seismic data. In general, 2-dimensional seismic surveys are used to collect seismic data over a broad area, 3-dimensional surveys are used to collect a much denser number of measurements over a smaller area, and 4-dimensional (or time lapse) surveys are used to collect dense measurements in the same small area repeatedly over time (International Association of Oil and Gas Producers and International Association of Geophysical Contractors 2011). Wide-azimuth seismic surveys collect

[59] Igneous and metamorphic rocks generally do not contain hydrocarbon reserves.

Table III-5. Stages of oil and gas development and activities, the purpose of each activity, and associated environmental effects

Stage of oil and gas development and activity	Purpose of activity	Environmental effects of concern for marine mammals
Exploration		
Seismic surveys	Locate and characterize geological structures that may contain hydrocarbon reserves	Acoustic disturbance from seismic sound source
		Disturbance from vessel and aircraft activity
Sediment sampling	Coring or sampling of surface and subsurface sediments to determine geophysical properties	Physical alteration or disturbance of bottom habitat
Exploratory drilling	Confirm presence of hydrocarbons; characterize physical properties of reservoir to determine economic feasibility	Disturbance from vessel and aircraft activity
		Physical alteration or disturbance of bottom habitat
		Chemical alteration and/or contamination of water or bottom habitat (from drilling muds and waste)
		Pollution from trash and debris
		Oil and gas spills and leaks
Well abandonment	Temporary or permanent capping and abandonment of exploratory well	Oil and gas spills and leaks
Construction and installation of platforms, pipelines, and other equipment		
Site survey and planning	Locate and characterize site-specific geological features and hazards, biologically sensitive areas, and archaeological resources	Acoustic disturbance from seismic sound source
		Disturbance from vessel and aircraft activity
Platform and equipment installation	Install (and anchor) drilling platform and equipment to seafloor to support long-term hydrocarbon production, storage, and offloading	Acoustic disturbance from pile driving
		Disturbance from vessel and aircraft activity
		Physical alteration or disturbance of bottom habitat
		Pollution from trash and debris
		Oil and gas spills and leaks
Pipeline seafloor survey	Locate and avoid bottom hazards, bottom-set fishing gear, biologically sensitive areas, and archaeological resources	Acoustic disturbance from sonar scanners
		Disturbance from vessel and aircraft activity
Pipeline installation	Install pipeline for transport of hydrocarbons to port or refinery	Disturbance from vessel and aircraft activity
		Physical alteration or disturbance of bottom habitat
		Pollution from trash and debris
		Oil and gas spills and leaks
Production and transport of hydrocarbons		
Seismic surveys	Monitor reserve volume and pressure during extraction	Acoustic disturbance from seismic sound source
		Disturbance from vessel and aircraft activity
Drilling	Extraction of oil and gas reserves for refinement and commercial sale	Disturbance from vessel and aircraft activity
		Physical alteration or disturbance of bottom habitat
		Chemical alteration and/or contamination of water or bottom habitat (from drilling muds and waste)
		Pollution from trash and debris

Stage of oil and gas development and activity	Purpose of activity	Environmental effects of concern for marine mammals
		Oil and gas spills and leaks
		Increased abundance or attraction of certain prey species to platforms
Transport	Transport of hydrocarbons to port or refinery via pipelines or tankers	Disturbance from vessel activity (tankers)
		Oil and gas spills and leaks (tankers and pipelines)
		Increased abundance or attraction of certain prey species to platforms
		Invasive species from tankers
Decommissioning and site clearance		
Explosive removal	Remove temporary or permanent structures or equipment from seafloor	Acoustic disturbance from explosives
		Disturbance from vessel and aircraft activity
		Pollution from trash and debris
		Oil and gas spills and leaks
Non-explosive removal	Remove temporary or permanent structures or equipment from seafloor	Disturbance from vessel and aircraft activity
		Pollution from trash and debris
		Oil and gas spills and leaks
Well abandonment	Permanent capping and abandonment of well	Oil and gas spills and leaks
Platform re-purposing (i.e., Rigs-to-Reefs)	Convert obsolete or non-productive platforms to artificial reefs	Increased abundance or attraction of certain prey species to platforms

seismic data from many different angles, and are used in the Gulf of Mexico to investigate oil trapped below salt bodies and other subsurface structures.

Seismic airguns emit high energy, low frequency acoustic pulses that travel long distances and may disrupt important marine mammal behaviors (i.e., feeding, resting, migrating, breeding, calving) and—at close range—can cause physical or physiological injury (Gordon et al. 2004). Noise also can mask biologically important sounds, such as communication calls between conspecifics (Richardson et al. 1995). Baleen whales are the most likely to be affected by seismic activity because of their sensitivity to low frequency sounds, but other cetaceans also may be adversely affected if close to the sound source.

Alternatives to marine seismic surveys may include the use of marine vibrators (vibroseis, which has been used on land for years), deep-towed acoustics/geophysics systems, low-frequency passive acoustic systems, and controlled source electromagnetic systems. Some have the potential to replace seismic airguns, but all are still in various stages of development and some are not yet commercially available for use (Weilgart 2010). There is indication that certain alternatives may have lesser impacts on marine mammals and other organisms as compared to seismic surveys (e.g., LGL and MAI 2011), but those effects have yet to be fully evaluated in a commercial setting.

Once seismic surveys are completed, confirmation of hydrocarbon reserves and decisions regarding the economic feasibility of developing an oil field can only be achieved by actual drilling. Exploratory drilling in offshore waters generally involves a single well drilled by a mobile offshore drilling unit. Drilling occurs over weeks, months, or even years depending on the depth of the well and other geophysical features, and can be delayed by weather, availability of equipment or personnel, safety concerns, or other issues. After exploratory drilling has ceased, wells are capped and abandoned either temporarily or permanently. Exploratory drilling poses risks to marine mammals from the sound generated during drilling and disturbance from surface and subsurface support vessels, aircraft, and other equipment. Drilling also can result in oil spills, which may affect marine mammals directly by contact, inhalation, or ingestion, or indirectly by effects on marine mammal prey or habitat. (See the previous section for a more thorough discussion of the potential effects of an oil spill on marine mammals.)

Construction and installation: If suitable oil and gas reserves are found, the next stage of development involves construction and installation of drilling platforms and transport systems (e.g., pipelines). Construction begins with site surveys and planning, which can involve high resolution geophysical surveys and associated noise effects. Pile driving during construction of shallow water platforms can be a significant source of loud, mid-frequency noise detectable up to 40km from its source (McIwem 2006). Both shallow and deep-water construction can require increased aircraft activity, increased vessel traffic (including remotely operated vessels) at the surface and at depth, and also increased debris from construction and support activities. Construction and anchoring of infrastructure and equipment also can alter or degrade bottom habitat. If oil is to be transported by pipeline, then construction also may involve pipeline building and, depending on circumstances, burial. If oil is to be transported by vessel, then, depending on circumstances, mooring systems may be required.

Production and transport: The production stage involves the drilling of multiple wells, extraction of crude oil and gas from the reservoir, and transport of the oil to refineries and the gas to markets either directly through pipelines or in tankers. Depending on the size of an oil reservoir and the recovery rate, an oil platform may be productive for three or four decades or longer. Seismic studies are repeated on a regular basis to guide drilling activities and monitor changes in the reservoir. Both drilling and seismic activities generate noise that may be harmful to marine mammals. Vessel and aircraft activity can create a constant source of disturbance, and vessel activity can increase the potential for vessel strikes and fuel spills. Drilling produces muds and cuttings that can be discharged near the well site, injected back into the ground, or collected and disposed of off-site. Depending on how they are managed, the muds and cuttings can introduce heavy metals and other toxic materials into the marine ecosystem (Neff 2010).

Decommissioning and site clearance: When economic conditions and conditions within the reservoir dictate, drilling and extraction of oil and gas are discontinued and the platform and associated infrastructure are decommissioned (e.g., platforms shut down and removed; pipelines emptied of oil, sealed, and buried; sites cleared of support equipment). This stage of development can result in disturbance of sediments and discharge of metals associated with the severance, removal, toppling, and/or destruction of platforms, wellheads, cables, and other equipment and structures. Decommissioning can involve various types of non-explosive cutter tools but, increasingly, a variety of explosives are being used to augment or replace mechanical cutters to sever and remove underwater structures (Minerals Management Service 2005). Both non-explosive and explosive methods can introduce significant noise into the marine environment. Abandoned wells have the potential to leak oil and gas, as noted above. Under certain circumstances, platforms (or portions of them) are left in place.

Hydrocarbon and other chemical spills and leaks: Spills and leaks can occur at all stages of oil and gas development, with varying effects based on the type of materials spilled and the amount (generally referenced as very large (>150,000 barrels), large (> 1,000 barrels), and small (<1,000 barrels)). Large and very large spills can occur from a blowout or other loss of well control or accidents that occur during loading, transport, and unloading of oil or gas from platforms to shore via vessels or pipelines. Smaller spills and leaks of oil, gas, or other chemicals also can occur from events such as storage tank accidents, transfer mishaps between supply vessels and drilling rigs, leaks from fuel tanks on support vessels, or from temporarily or permanently abandoned wells.

Spills and leaks can cause acute injury or mortality or longer term, sublethal effects and can degrade marine habitat. Methane and other gas leaks are generally less problematic for marine organisms than oil or other chemicals because of their volatility and rapid dissipation; however, methane is an important greenhouse gas and a significant contributor to climate disruption (Reay et al. 2010).

Response activities to contain oil spills and clean up surface, subsurface, or shoreline oil also have the potential to affect marine species through increased vessel and air traffic and noise. During the Deepwater Horizon spill, chemical dispersants were used both at the surface and at depth to disperse oil. However, little is known about the direct effect of dispersants on the marine environment (National Research Council 2005). The use of booms and skimmers to contain and collect surface oil and the in-situ burning of oil have the potential to disturb marine species. Burning reduces the overall amount of oil in

the marine environment, but it also leaves behind a residue of uncertain composition and toxicity (Benner et al. 1990, Wang et al. 1999) and puts additional chemicals into the air.

Mitigation, monitoring, and reporting

In many cases, action agencies can prevent or reduce the adverse effects of oil and gas development by using targeted mitigation measures. Mitigation may include ramping up the sound source to alert marine mammals that may be in the area, shutting down or powering down the sound source if marine mammals approach the sound source close enough to be injured,[60] and prohibiting airgun operations during nighttime or low visibility conditions. To minimize the probability of vessel strikes, vessels may be required to slow down or avoid multiple changes in direction within a certain distance from marine mammals. Airplanes operating in the area may be required to fly above a certain altitude to avoid disturbing marine mammals that may be at the surface. Proposed activities also may be prohibited from sensitive areas at sensitive times. Although the development of general and site-specific mitigation measures are based on observations of individual animals exposed to various industrial activities, the effectiveness of mitigation to avoid adverse impacts on marine mammal populations often is uncertain.

Monitoring serves two main functions. First, it may be necessary to prompt mitigation measures. For example, monitoring is necessary to determine when marine mammals are too close to a sound source and the source must be shut down. Second, it provides information needed to determine the effects of an activity (i.e., the number of marine mammals taken and the nature of the takes). For sound producing activities, the size of the area to be monitored is determined using either in-situ sound measurements or modeling based on the properties of the sound source (source level and frequency) and the propagation of sound through the water. In certain circumstances, visual observations may be supplemented by passive acoustic monitoring to increase the probability of detecting marine mammals (e.g., in low visibility conditions). Passive acoustic monitoring also may provide an index of an activity's effects.

Marine mammal sightings are documented and reported to the agency issuing the incidental take authorization (i.e., the National Marine Fisheries Service or the Fish and Wildlife Service). Reporting is typically required on a periodic basis during a project and at its completion. Immediate reporting and suspension of operations may be required if a dead or seriously injured marine mammal is found in the vicinity of an operation and the death or injury might have been caused by the operation.

In January 2011, the Council on Environmental Quality issued guidance on the appropriate use of mitigation and monitoring and clarified the appropriate use of mitigated "Findings of No Significant Impact" under the National Environmental Policy Act. The guidance states that agencies may commit to mitigation measures to achieve an environmentally preferable outcome, but that agencies must document and monitor mitigation commitments to determine if the mitigation was implemented and effective. Failure to document and monitor mitigation measures "may fail to advance the National Environmental Policy Act's purpose of ensuring informed and transparent environmental decision-making" and also may undermine the integrity of the National Environmental Policy Act review.

In accordance with the Council's guidance, the Marine Mammal Commission has made repeated recommendations to the National Marine Fisheries Service that they track and assess the oil and gas industry's implementation of mitigation and monitoring measures required under both the National Environmental Policy Act and the Marine Mammal Protection Act. Such tracking and assessment are

[60] Under current National Marine Fisheries Service guidelines, "exclusion zones" for marine mammals around industrial sound sources are defined as the distances within which received sound levels are ≥180 dB re 1 μPa (rms) for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those criteria are based on the assumption that sound energy at lower received levels will not injure the animals or impair their hearing abilities but that higher received levels might have some such effects. "Harassment zones" are defined as the distances within which received sound levels are ≥160 dB re 1 μPa (rms) for impulsive sound sources and ≥120 dB re 1 μPa (rms) for non-impulsive sound sources. Distances < 500 m from seismic sonar arrays are judged to be within the marine mammal exclusion zones in the Gulf of Mexico [http://www.nmfs.noaa.gov/ocs/mafac/meetings/2010_06/docs/mms_2007_ntl.pdf]

necessary to ensure that mitigation and monitoring measures are executed as expected and have the intended effect.[61]

Information needs

As noted in the previous section, the individual and cumulative effects of oil and gas activities on the survival and reproduction of marine mammal populations over time are largely unknown, despite the long history of oil and gas development activities in U.S. waters. The lack of baseline information is one of the main obstacles to understanding such effects. Such information should include their stock structure, distribution, abundance, movement patterns, age structure, reproductive rates, survival rates, and health (nutritional status, immune function, and exposure to contaminants, biotoxins, and pathogens).

Describing baseline conditions is not a trivial task. Because the physical and biological properties of ecosystems vary, such conditions should include both measures of central tendency (e.g., mean, median, mode) as well as patterns in and variability about those measures. Often, patterns are most apparent over space and time (e.g., coastal versus pelagic, shallow versus deep, open water versus ice-covered). Assessment of baseline conditions is further complicated by directional trends in ecosystems, such as those caused by climate disruption. Although pristine baseline conditions may no longer exist, assessing conditions at the beginning of an activity (e.g., an oil and gas operation) is still important for measuring possible effects. Failure to do so may simply perpetuate the sliding baseline phenomenon.

The resistance to collection of baseline information stems from two main sources. First, the necessary studies often are expensive and require considerable support of scientists and infrastructure. Such problems are complicated further in places like the Arctic, where the logistics of such studies are themselves a considerable challenge. Although the United States generally advocates for science-based decision making, the necessary studies have simply not been funded. The lack of baseline information on marine mammals was a major concern expressed after the *Exxon Valdez* spill in 1989, and will still be a resounding problem in assessing the effects of the Deepwater Horizon spill.

Second, the necessary studies also require considerable time—years, if not decades for highly variable ecosystems. In contrast, the time frame for decisions in the oil and gas industry and the agencies managing the industry is considerably shorter, and the demand for oil repeatedly outweighs a more deliberate, well-informed approach—the pending decisions regarding oil and gas operations in the Arctic being an example. There, federal regulators and industry have forged ahead with exploration and development activities with only limited information on pre-development environmental conditions. Environmental assessments have been concentrated in limited areas and periods during breaks in exploration and development activities. And the data generally are not integrated into a more robust, comprehensive assessment of the affected ecosystem. In short, our nation's approach appears to be dominated largely by urgent demand and, in the Commission's view, that approach is not consistent with the goal of sustaining healthy marine ecosystems.

The Commission also believes that the Bureau of Ocean Energy Management—the regulator of oil and gas development in offshore waters—must work with the industry to support the research needed to ensure that the activities it permits and manages are environmentally safe. Although the responsibility for research and management of marine mammals also falls on the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, it has long been clear that the Service has not been able to fulfill its role to the extent needed because of inadequate funding. If that dilemma is to be resolved, it will require either that Congress provide more funding for the Service directly, or that Congress and the Bureau devise a means for obtaining the needed resources from the industry.

Gulf of Mexico: The need for such research support is clearly evident in the Gulf of Mexico, where the research effort to date has been sufficient to provide reasonable baseline data for only a handful of the

[61] See, for example, the Commission's recommendations to the National Marine Fisheries Service regarding Shell Offshore, Inc.'s application for an incidental harassment authorization associated with proposed exploratory drilling activities in the Beaufort and Chukchi Seas (letters dated 9 December 2011).

57 marine mammal stocks identified there. The Deepwater Horizon oil spill highlighted how little we know about the Gulf of Mexico marine ecosystem, its various biological components, and their vulnerability to oil and gas operations, including spilled oil. Prior to the spill, the Minerals Management Service (2008) described the potential impacts of oil and gas operations on marine mammals as follows:

> Routine events related to a proposed action [in the Central or Western Planning Areas], particularly when mitigated as required [by the Minerals Management Service], are not expected to have long-term adverse effects on the size and productivity of any marine mammal species or population endemic to the northern Gulf of Mexico. Characteristics of impacts from accidental events depend on chronic or acute exposure, resulting in harassment, harm, or mortality to marine mammals, while exposure to dispersed hydrocarbons is likely to result in sublethal impacts. The effects of the incremental contribution of a proposed action, including the 181 South Area, combined with [other] activities may be deleterious to cetaceans occurring in the Gulf of Mexico. Biological significance of any mortality would depend, in part, on the size and reproductive rates of the affected stocks, as well as the number, age, and size of animals affected.

The information referenced in that statement is available only for a few stocks (i.e., sperm whales, a few bottlenose dolphin stocks). The Marine Mammal Commission has written to the Bureau on several occasions recommending that it implement a coordinated and comprehensive assessment of ecosystem baseline conditions before oil and gas operations (including exploration) progress further. Although the Bureau has made efforts to do so in the Gulf (e.g., cetacean surveys in the mid-1990s; recent studies of sperm whale responses to seismic surveys (Jochens et al. 2008)) and although those efforts provided much valuable information, they did not produce enough of the right kind of data to ensure an adequate baseline for assessing the effects of oil and gas development. More information is needed on abundance, distribution, movement patterns, population structure, vital rates, foraging patterns, contaminant loads, health and condition, and vulnerability to other threats. Therefore, on 3 January 2011 the Marine Mammal Commission repeated a recommendation to the Bureau that it consult with the National Marine Fisheries Service, the Fish and Wildlife Service, and the Marine Mammal Commission to develop a set of standards for baseline information needed to assess the effects of oil and gas operations on marine mammals and their environment.

To address data needs for oil and gas development in the Gulf of Mexico, the Bureau's Environmental Studies Program initiated or continued the following research projects in recent years—

- Seismic survey mitigation measures and marine mammal observer reports: this study was undertaken to synthesize and summarize submitted seismic survey observer reports for the years 2003 to 2008. A final report is expected in 2012, and the results will be used to determine the effectiveness of required mitigation measures and to develop recommendations for new and/or improved measures.
- Sperm whale acoustic prey study: this study was undertaken to characterize the species composition and biomass of mid-water squid and small pelagic fish in the Gulf of Mexico that constitute the apparent forage base for sperm whales. It was initiated in 2009 and conducted in 2010, before the Deepwater Horizon oil spill occurred. It provided critical pre-spill information on distribution and contaminant levels of sperm whale prey species, thereby emphasizing the value of baseline studies.
- Sperm whales and bottlenose dolphins in the Gulf of Mexico: this study was undertaken to obtain information about sperm whales from areas less affected by human activities in the eastern Gulf, and to collect information on the relatedness, seasonal movements, and population structure of target estuarine and coastal stocks of bottlenose dolphins. The study was initiated in response to the Deepwater Horizon oil spill and was ongoing at the end of 2011.

Alaska: The Arctic, and particularly Alaska, remains an area of intense interest for oil and gas development. Oil and gas activities in the Arctic present unique risks to marine ecosystems and great

challenges regarding oil spill prevention and response. Arctic marine ecosystems are particularly vulnerable to oil and gas operations, with all their incumbent risks, because of their unique biota, remoteness, harsh conditions, and lack of infrastructure. The Arctic also is home to Alaska Native communities who depend on the living marine resources for subsistence purposes and may be greatly affected by oil and gas operations.

The Bureau and the oil and gas industry have collected a great deal of information in Alaska about marine mammal distribution and effects of exploratory and development activities.[62] However, most of that information has been focused on bowhead whales, and collected in the summer and early autumn, during the open-water period. An ecosystem-wide, integrated synthesis of available information from year-round monitoring would help identify important data gaps that exist for other Arctic marine mammals, particularly for lesser-studied species such as beluga whales, walruses, polar bears, and ice seals. It also would help the agencies better understand and predict the long-term, cumulative effects of the proposed activities, in light of increasing human activities in the Arctic and changing climatic conditions.

In 2011, the U.S. Geological Survey completed its evaluation of the science needs to inform decisions on outer continental shelf energy development in the Chukchi and Beaufort Seas (Holland-Bartels and Pierce 2011). To predict the expected effects of oil and gas and other activities more accurately, the Survey stated that a broader synthesis and integration of available information on bowhead whales and other marine mammals is needed. That synthesis should incorporate such factors as ambient sound levels, natural and anthropogenic sound sources, abundance, movement patterns, the oceanographic features that influence feeding and reproductive behavior, and traditional knowledge. The Survey recommended also that the development of an inventory/database of seismic sound sources used in the Arctic would be a good first step toward a better understanding of long-term, population-level effects of seismic and drilling activities.

The Bureau's Environmental Studies Program for Alaska is described in detail in its Annual Studies Plans (Bureau of Ocean Energy Management 2010). The Bureau's Alaska region expends a significant portion of the Bureau's annual budget for environmental studies, and the projects it undertakes address a variety of physical, biological, and social issues. Projects in 2010 and 2011 pertaining directly to marine mammals include—

- Chukchi offshore monitoring in drilling area (COMIDA): this study was undertaken to investigate the distribution and relative abundance of marine mammals in the Chukchi Sea Planning Area during the open water months of June-October, when various species are undertaking seasonal migrations through the area. Based primarily on aerial surveys, the project was conducted by researchers from the National Marine Fisheries Service's National Marine Mammal Laboratory. The study was initiated in 2008 and a final report was published in February 2011 (Clarke et al. 2011).
- Bowhead whale aerial survey program (BWASP) extension: the Minerals Management Service (later Bureau of Ocean Management) has conducted aerial surveys of the fall migration of bowhead whales in the Beaufort Sea each year since 1987. The project was extended in 2011 to inform decisions on environmental assessment and exploration monitoring for oil and gas activities in the Beaufort Sea. This is another example of a series of studies that illustrate the value of good baseline information.
- Marine mammal/physical oceanography synthesis: this study was undertaken to increase scientific understanding of the relationships between oceanographic conditions, lower trophic prey species, and marine mammal distribution and behavior in the Chukchi Sea lease area and adjacent waters, and to enhance capability to predict future changes in oceanographic features. The study will synthesize research from previous and ongoing studies in the region, including aerial surveys and passive acoustic monitoring of bowhead whales, walrus, and pinnipeds, as well as other ecosystem

[62] http://www.afsc.noaa.gov/NMML/cetacean/bwasp/index.php; www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_COMIDA.php

studies. Here, too, this study will begin to provide important baseline information on the ecology of the potentially affected marine ecosystem.

Atlantic: If oil and gas development moves into the Atlantic, baseline information should be collected prior to exploration and development. In 2009, the Bureau, in collaboration with the Navy, committed to providing multi-year funding to the National Marine Fisheries Service for the Atlantic Marine Assessment Program for Protected Species (AMAPPS). That program has been undertaken to address data needs for development of both renewable energy and oil and gas, including abundance and seasonal distribution data for marine mammals and other wildlife. It was due to start in 2010 but was delayed until 2011 because the ship designated for the survey was diverted to the Gulf of Mexico to assist in the Deepwater Horizon oil spill response. The Commission commends that type of joint effort and believes similar efforts should be a high priority for the Bureau in all established or proposed energy development areas.

Current oil and gas production, consumption, and reserve levels

In 2011, oil and gas production from all U.S. offshore resources was 24 percent and 8 percent, respectively, of total domestic production,[63] the remainder being from land-based sources. Considering only offshore areas, the Gulf of Mexico still holds the largest reserves of both oil and gas, followed by Alaska (Figure III-13) (Bureau of Ocean Energy Management 2011b). Oil production has been steady in the Gulf and it remains the most important offshore region in the U.S. for oil and gas production, followed by the Pacific and Alaska (Figures III-14 and III-15). In 2010, the Gulf contributed 29 percent of total domestic oil and 12 percent of total domestic gas production.[64]

By country, the United States is third in production of oil but first in consumption (Tables III-5 and III-6). It imports oil and petroleum products because it does not produce enough to meet its demand. Oil and gas imports peaked in 2005, but have been decreasing since then.[65] In 2011 the United States

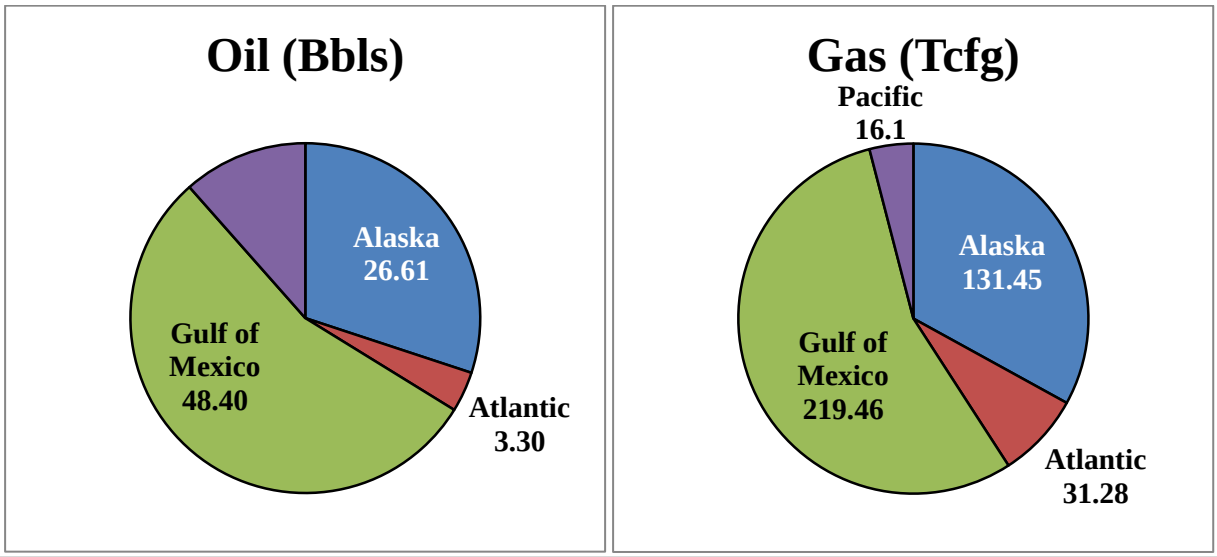

Figure III-13. Mean undiscovered technically recoverable resources by type and region, 2011: Oil in billions of stock tank barrels (Bbls) and gas in trillion standard cubic feet of gas (Tcfg). (Bureau of Ocean Energy Management 2011b)

[63] http://www.eia.gov/special/gulf_of_mexico/data.cfm#petroleum_fuel_facts
[64] U.S. Energy Information Administration, http://www.eia.gov/special/gulf_of_mexico/index.cfm
[65] http://www.eia.gov/energy_in_brief/foreign_oil_dependence.cfm

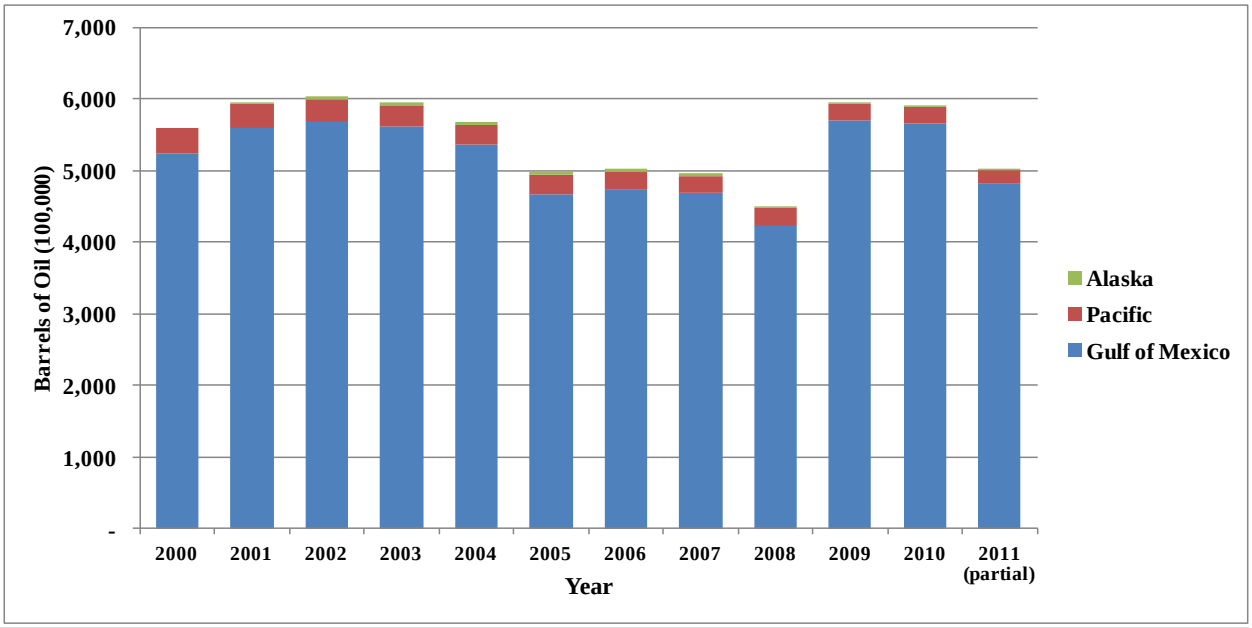

Figure III-14. Oil production by U.S. outer continental shelf region from 2000-2011 (Bureau of Ocean Energy Management)

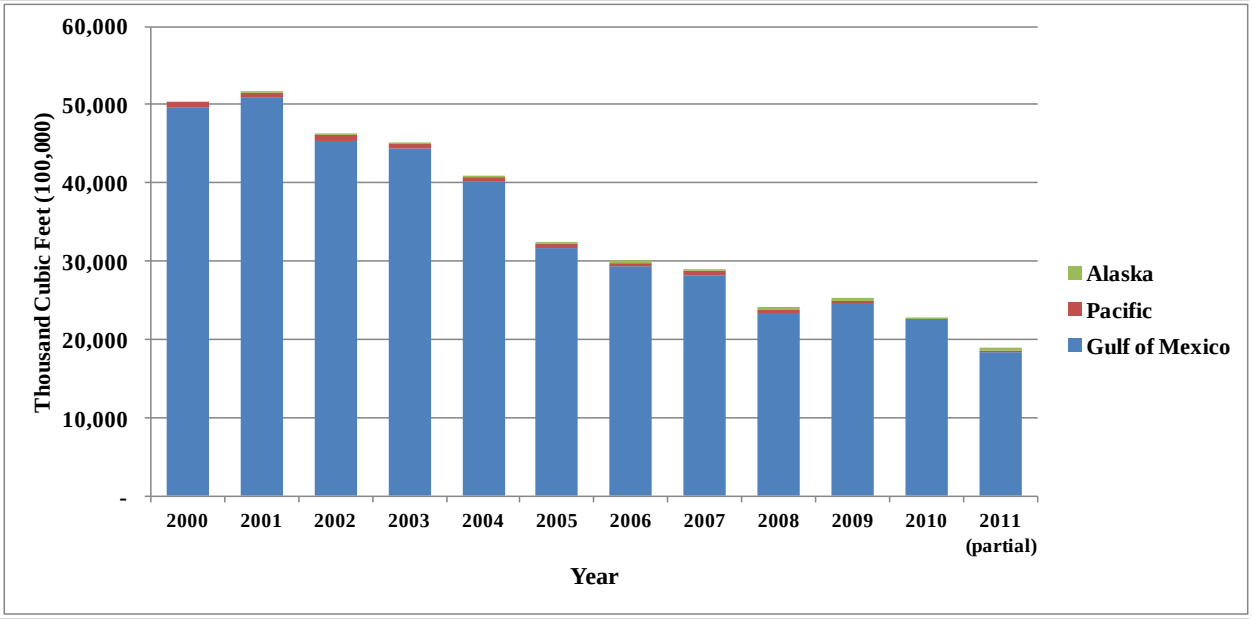

Figure III-15. Natural gas production by U.S. outer continental shelf region from 2000-2011 (Bureau of Ocean Energy Management)

imported about 11,400 thousand barrels of oil and petroleum products per day, 60 percent of its total demand. Major suppliers included Canada (29 percent), Saudi Arabia (14 percent), Venezuela (11 percent), Nigeria (10 percent), and Mexico (8 percent). At the same time, the United States does not consume all of the oil it produces, and in 2011 it exported about 2,900 thousand barrels per day. Net imports (imports minus exports) were about 8,500 thousand barrels per day. The major uses of petroleum in the United States are for industrial purposes (30 percent) and transportation of goods and people (28 percent) (U.S. Energy Information Administration 2010).

Table III-6. Top 15 producers of oil in the world, 2011 (U.S. Energy Information Administration)

Rank	Country	Production (1,000 barrels/day)	Percent of worldwide total
1	Saudi Arabia	11,153	12.8%
2	Russia	10,229	11.7%
3	United States	10,088	11.6%
4	China	4,303	4.9%
5	Iran	4,234	4.9%
6	Canada	3,665	4.2%
7	United Arab Emirates	3,096	3.6%
8	Mexico	2,959	3.4%
9	Kuwait	2,682	3.1%
10	Brazil	2,641	3.1%
11	Iraq	2,635	3.0%
12	Nigeria	2,528	2.9%
13	Venezuela	2,470	2.8%
14	Norway	2,007	2.3%
15	Algeria	1,884	2.2%

Table III-7. Top 15 consumers of oil in the world, 2011 (U.S. Energy Information Administration)

Rank	Country	Consumption (1,000 barrels/day)	Percent of Worldwide Total
1	United States	18,835	21.4%
2	China	9,790	11.1%
3	Japan	4,481	5.1%
4	India	3,292	3.7%
5	Russia	3,145	3.6%
6	Saudi Arabia	2,817	3.2%
7	Brazil	2,594	2.9%
8	Germany	2,423	2.7%
9	Canada	2,239	2.6%
10	South Korea	2,227	2.5%
11	Mexico	2,078	2.4%
12	France	1,824	2.0%
13	Iran	1,694	1.9%
14	United Kingdom	1,602	1.8%
15	Italy	1,455	1.8%

Moving toward energy independence

Efforts to reduce the United States' dependency on foreign oil generally are viewed as vital to the nation's energy security. At the same time, efforts to develop offshore U.S. oil and gas reserves pose considerable challenges as well as risks to marine ecosystems. Because of the risks posed to marine mammals and ecosystems, the Marine Mammal Commission has commented on several occasions to the Bureau of Ocean Energy Management that the United States has faced an impending energy crisis for decades but has neither responded with adequate foresight and commitment to address the crisis in its earlier stages nor shown the foresight to reduce our national dependence on hydrocarbons and minimize

the production of greenhouse gases.[66] A thoughtful and farsighted energy plan is needed to move the nation beyond efforts aimed simply at finding the next oil field. If left unchanged, the present course could have a number of undesirable consequences, including such things as spills (e.g., *Exxon Valdez*, Deepwater Horizon) as well as poorly regulated emissions from the use (burning) of fossil fuels. For those reasons, the Commission has recommended that the Bureau work with the Department of Energy to develop a long-term national energy strategy that will reduce the environmental risks being imposed by the nation's current dependence on oil and gas for energy.

Offshore Development of Renewable Energy

The global development of certain types of renewable energy sources—wind, wave, solar, geothermal, biofuel, waste-to-energy, and tidal energy—represents a positive move away from more traditional, non-renewable sources of energy, especially fossil fuels. Not only are fossil fuel resources in finite supply, but locating, extracting, and transporting them poses considerable risk to the environment and human health. Burning fossil fuels produces carbon dioxide and other greenhouse gases that contribute to climate disruption. Increased production of renewable energy is intended to bring our nation closer to the goal of energy independence.[67] Such dependence has been decreasing steadily, but much remains to be done—in 2010, 49 percent of the oil consumed in the United States was from foreign sources.[68] Despite the need for energy independence, the United States has been slow to develop renewable energy sources, primarily because of the considerable investment and new infrastructure required before this emerging industry can deliver reliable and consistent energy supplies at a rate competitive with fossil fuels. Not surprisingly, political support for renewable energy—crucial for its expansion—wavers with the cost of fuel.

Renewable energy production levels and targets

The United States, China, and the European Union are leading the development of renewable energy capacity. In China, renewable energy accounted for 26 percent of electric power generation in 2010, and 9 percent of final energy consumption. China leads the world in production of wind turbines and solar panels, and their goal is to have 15 percent of final energy consumption from renewable energy (including nuclear energy) by 2020.[69] The European Union has a dual goal of 20 percent of electricity generated from renewable energy sources and a 20 percent reduction in energy consumption by 2020.[70] Seven of the 27 European Union countries—Denmark, Germany, Hungary, Ireland, Lithuania, Poland, and Portugal—were on track to reach the 2010 interim target, based on information provided to the European Commission in January 2011.[71] Half of the European countries likely will meet or exceed their targets by 2020 because of advances in energy efficiency and because, in the next decade, renewable energy is now projected to grow faster than originally expected.[72]

The Department of Energy has identified target scenarios for wind energy development (54 gigawatts and 20 percent renewable energy from wind by 2030) (Department of Energy 2008, 2011).

[66] Most recently, the Marine Mammal Commission recommended that the Bureau of Ocean Energy Management (and its predecessors) work with the Department of Energy and related agencies to develop a national energy policy, in the Commission's comments on (1) the Environmental Impact Statement for the Outer Continental Shelf Oil and Gas Leasing Program for 2012–2017, dated 30 June 2010, and (2) the Draft Supplemental Environmental Impact Statement for the Chukchi Sea Planning Area Oil and Gas Lease Sale 193, dated 6 December 2010.
[67] http://www.huffingtonpost.com/2011/04/06/obama-energy-independence_n_845702.html
[68] http://www.eia.gov/energy_in_brief/foreign_oil_dependence.cfm
[69] http://www.martinot.info/china.htm#targets
[70] European Commission Directive 2009/28/EC, 23 April 2009, eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=Oj:L:2009:140:0016:0062:en:PDF
[71] http://ec.europa.eu/energy/renewables/reports/reports_en.htm
[72] http://ec.europa.eu/energy/renewables/reports/reports_en.htm

However, the United States does not have a national renewable energy target despite legislation introduced in both the House of Representatives and the Senate in the 111th Congress to establish a Federal Renewable Energy Standard.[73] Instead, individual states are driving renewable energy development by establishing their own targets. By the end of 2011, 29 states plus the District of Columbia and Puerto Rico had established renewable energy standards; another eight states had renewable energy goals (Table III-8).[74] Overall, renewable energy sources contributed 10.4 percent of total domestic electricity generated in 2010, with the majority of that coming from hydropower sources (6.3 percent).[75] Although energy production from hydropower is expected to remain relatively stable, non-hydropower renewable energy contributions to domestic electricity are expected to increase from about 4 percent in 2010 to 9 percent by 2035.[76]

Regulatory framework for renewable ocean energy

In 2005 Congress passed the Energy Policy Act, which recognized the significant potential for offshore renewable energy to address increasing energy demands in the United States and to move the country closer to energy independence. The Act delegated to the Department of the Interior the responsibility and authority for leasing and granting easements and rights-of-way for renewable energy development on the outer continental shelf.[77] The Act also required that the development of renewable energy be carried out in a way that is safe, protects the environment, prevents waste, conserves natural resources, is coordinated with other federal agencies, protects national security interests, protects correlative rights on the outer continental shelf, considers and/or prevents interference with other reasonable uses (such as military operations, shipping, and oil and gas exploration), provides for public notice and comment, and ensures oversight, inspection, research, monitoring, and enforcement of the lease, easement, or right-of-way.

The Energy Policy Act also calls on the Department to follow a process for offshore renewable energy leasing similar to that for oil and gas leasing, but with some important differences. Leases are to be issued on a competitive basis, as with oil and gas, unless the Secretary determines that there is no competitive interest. The Department is required to coordinate all leasing and permitting with federal, state, and local officials, and to provide 27 percent of all revenues collected to adjacent coastal states.

Since the Act's passage, the Bureau has taken several steps to facilitate the development of renewable energy on the outer continental shelf. In 2007 it issued an interim policy to authorize the installation of offshore data collection and technology testing facilities (such as meteorological towers) to assess renewable energy resources. Final regulations implementing the Act were issued in 2009, outlining the process by which leases, easements, and rights-of-way would be issued to support production and transmission of renewable energy and how revenues would be shared with coastal states (74 Fed. Reg. 19638). The Secretary of the Interior signed the first commercial lease for offshore wind energy in October 2010 with Cape Wind Associates. The next month the Secretary launched the Department's "Smart-from-the-Start" initiative to expedite the development of other offshore wind energy projects off

[73] Bills introduced in the 111th Congress that would establish a Federal Renewable Energy Standard were H.R. 2454 ("American Clean Energy and Security Act of 2009") and S. 1462 ("American Clean Energy Leadership Act of 2009").

[74] Renewable portfolio standards require utilities to use renewable energy or renewable energy credits to account for a certain percentage of their retail electricity sales -- or a certain amount of generating capacity -- according to a specified schedule; renewable portfolio goals are similar but not legally binding (Source: Department of Energy Database of State Incentives for Renewables and Efficiency, http://www.dsireusa.org/).

[75] http://www.eia.gov/renewable/state/pdf/srp2010.pdf

[76] http://www.eia.gov/forecasts/archive/aeo12/pdf/0383%282012%29.pdf

[77] Public Law 109-58, 8 August 2005. Outer continental shelf refers to all submerged lands, subsoil, and seabed lying between the seaward extent of state water boundaries out 200 nautical miles to the U.S. Exclusive Economic Zone. State waters typically end three miles from shore (nine miles in the case of Texas and the Gulf Coast of Florida). For more details, http://see www.boemre.gov/offshore/mapping/OCSPolicyInfo.htm.

Table III-8. U.S. states with renewable energy standards/goals (Department of Energy database of state incentives for renewables and efficiency)

State	Standard or goal	Renewable energy (RE) target (percent)	Year
Arizona	Standard	15	2025
California	Standard	33	2020
Colorado	Standard	30	2020
Connecticut	Standard	27	2020
Delaware	Standard	25	2026
District of Columbia	Standard	20	2020
Hawaii	Standard	40	2030
Illinois	Standard	25	2025
Indiana	Goal	15	2025
Iowa	Standard	105 MW	--
Kansas	Standard	20	2020
Maine	Standard	40 10(new resources)	2017 2017
Maryland	Standard	20	2022
Massachusetts	Standard	15 (new resources + 1 percent annually thereafter)	2020
Michigan	Standard	10 plus 1,100 MW	2015
Minnesota	Standard	25	2025
Missouri	Standard	15	2021
Montana	Standard	15	2015
Nevada	Standard	25	2025
New Hampshire	Standard	23.8	2025
New Jersey	Standard	20.38	2021
		5,316 GWh solar	2026
New Mexico	Standard	20 (investor-owned utilities) 10 (co-ops & large municipalities)	2020
New York	Standard	29	2015
North Carolina	Standard	12.5 (investor-owned utilities) 10 (co-ops & municipalities)	2021 2018
North Dakota	Goal	10	2015
Ohio	Standard	25	2025
Oklahoma	Goal	15	2015
Oregon	Standard	25 (large utilities) 5-10 (smaller utilities)	2025
Pennsylvania	Standard	~18	2021
Puerto Rico	Standard	20	2035
Rhode Island	Standard	16	2020
South Dakota	Goal	10	2015
Texas	Standard	5,880 MW	2015

State	Standard or goal	Renewable energy (RE) target (percent)	Year
Utah	Goal	20	2025
Vermont	Goal	20	2017
Virginia	Goal	15	2025
Washington	Standard	15	2020
West Virginia	Goal	25	2025
Wisconsin	Standard	~10 (varies by utility)	2015

the Atlantic Coast. That initiative streamlined the regulatory process for leasing of sites with only one qualified and interested developer. It also emphasized a stakeholder-driven, iterative process for identification of both potential lease sites and potential conflicts as part of the planning and analysis stage prior to offering lease sales, consistent with the coastal and marine spatial planning process envisioned in the Administration's new National Ocean Policy, as outlined in Executive Order 13547.

In its letters, the Marine Mammal Commission has commended the Administration for its efforts to accelerate the development of offshore renewable energy and meet the Administration's goal of generating 80 percent of the nation's electricity from clean energy sources by 2035.[78] The Commission has commented frequently on the need for a long-term national energy strategy and agrees that renewable energy sources must be an important part of that strategy. Nevertheless, as with any new industrial activity proposed in U.S. coastal and offshore waters, the Commission believes that the development of alternative energy sources should proceed in a thoughtful and deliberate manner.

Ocean renewable energy sources, potential impacts, and status of development

The Commission's main concerns with regard to offshore alternative energy focus on potential interactions of marine mammals with geological and geophysical surveys conducted by industry to assess the suitability of sites for offshore renewable energy development, and the construction, operation, and decommissioning of renewable energy facilities in coastal and offshore waters. Energy sources include those derived from wind and hydrokinetics (waves, tides, and currents).

Wind energy: Wind energy is a potentially large source of renewable energy from offshore waters. Wind energy turbines used commercially in offshore waters generally are horizontal-axis wind turbines with a fixed or floating structure supporting a tower with three large blades. As with wind turbines generally, the blades rotate in the wind, converting kinetic energy to mechanical energy. The mechanical energy is used to produce electricity, which is then transmitted to land.

Offshore wind turbines have certain benefits compared to land-based wind operations. Once constructed, they tend to be larger and more stable than those used on land. Because they are larger, they also produce more energy. If sited far enough offshore they may raise less concern among the public and land owners about visual impacts. On the other hand, power companies will require considerable new infrastructure to transmit electricity generated offshore to land. Although the United States leads the world in wind energy generation, with 40.2 GW generated in 2010, all of that energy was generated on land.[79] At the end of 2011, the U.S. had yet to generate any wind energy from offshore wind resources, despite considerable offshore wind resources (Figure III-16). The world leaders in offshore wind energy development in 2010 were the United Kingdom (1.2 GW), Denmark (0.9 GW), Netherlands (0.2 GW), China (0.1 GW), and Japan (0.02 GW) (Figure III-17).[80]

[78] State of the Union address, 25 January 2011. Clean energy includes renewable energy sources, yet also includes non-renewable sources such as natural gas, clean coal, and nuclear power.
[79] http://www.un-energy.org/sites/default/files/share/une/ren21_gsr2011.pdf
[80] http://www.un-energy.org/sites/default/files/share/une/ren21_gsr2011.pdf

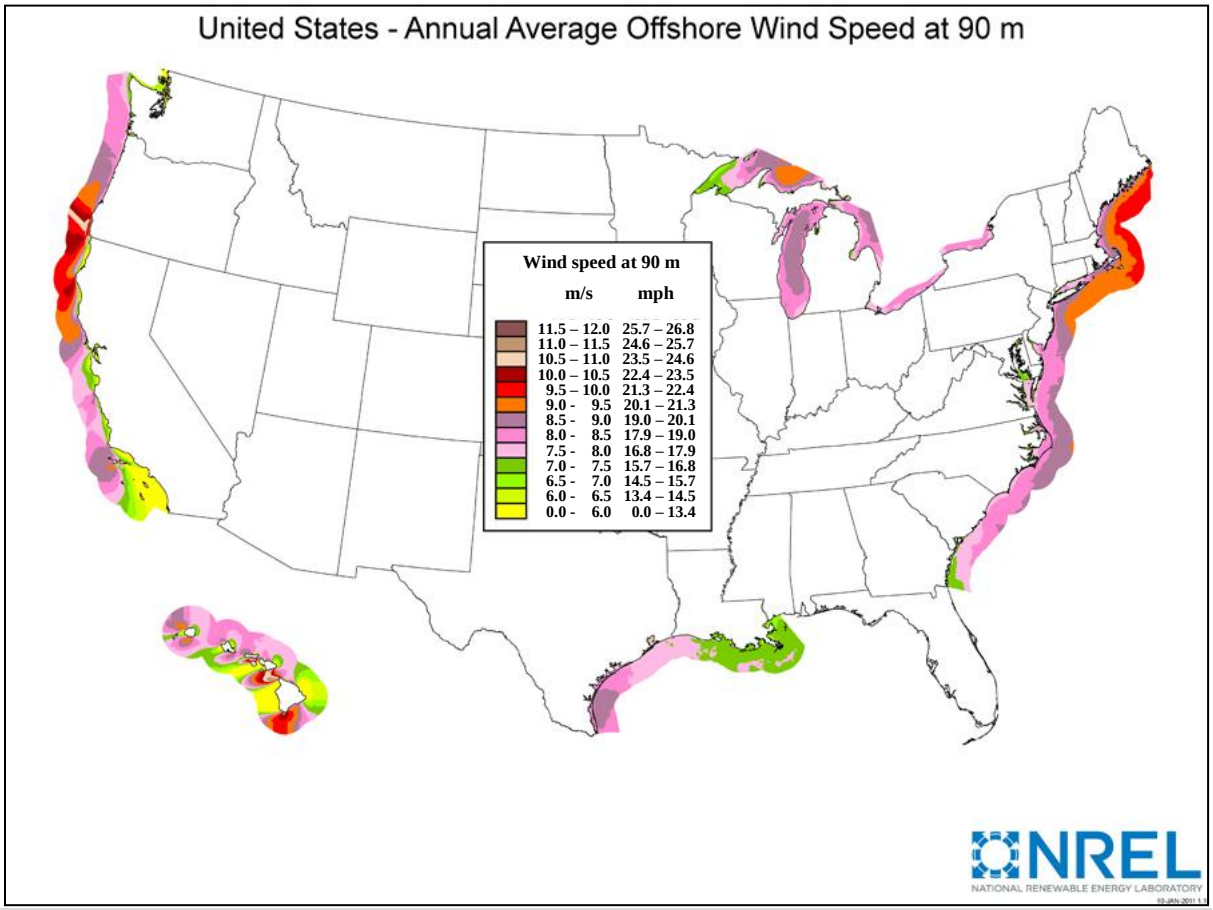

Figure III-16. U.S. offshore wind resources at 90 m above the surface (Schwartz et al. 2010/National Renewable Energy Laboratory)

Risks to marine mammals: Offshore wind is not without potential risks to marine mammals. Sub-bottom profilers used for geophysical surveys and site characterization generate source levels (201–205 dB re 1µPa at 1 m) and frequencies (0.5–24 kHz) comparable to other sound sources that pose risks to marine mammal physiology (e.g., hearing) and behavior (e.g., habitat use) (Cox et al. 2006, Gordon et al. 2004) and may lead to more serious consequences (e.g., stranding). Pile driving for construction of meteorological towers and wind turbines generates low-frequency sound impulses that are detectable up to 40 km from the source (McIwem 2006), could impair hearing in marine mammals at close range (Madsen et al. 2006), and could lead to changes in behavior at intermediate distances, including temporary displacement (Scheidat et al. 2011) . Increased vessel activity associated with

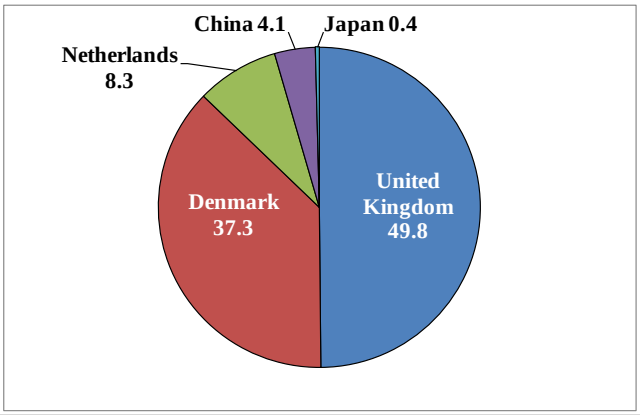

Figure III-17. Percent of total offshore wind energy generated in 2010, by country (REN21 2011)

construction of meteorological towers, deployment of meteorological buoys, and construction and operation of wind turbines may contribute to disturbance and increase the risk of vessel collisions with marine mammals (Laist et al. 2001). Cables transmitting energy generated from wind turbines to shoreside facilities generate electromagnetic energy, which has the potential to affect elasmobranchs (sharks and rays) and other fish species, marine mammals, sea turtles, and invertebrates (Normandeau et al. 2011). Pile driving, anchoring of wind platform structures, and the laying of transmission cables can temporarily or permanently disturb benthic habitats and prey species. Apart from potential impacts to marine mammals, wind energy also has the potential to interact with birds and bats, and to disturb benthic habitats.

The federal leasing process: The Bureau of Ocean Energy Management regulates leasing of wind energy sites on the outer continental shelf. The Bureau can issue limited leases for the installation of offshore data collection and technology testing facilities under its 2007 interim policy. However, those leases confer no commercial rights to further development. The Bureau conducts leasing for commercial development of wind energy sites in four stages: (1) planning and analysis of potential lease areas (also known as wind energy areas under the Smart-from-the-Start program), (2) lease issuance, (3) approval of a site assessment plan, and (4) approval of a construction and operation plan.

During the planning stage, states can request that the Bureau establish a regional task force comprised of federal, state, and tribal representatives to identify potential lease sale areas that the Bureau then uses as the basis for its proposed lease area. The task force also can provide input to the Bureau on unsolicited lease requests, and on matters pertaining to site assessment, construction, and operations. In addition, the task force can provide input on the environmental effects of proposed activities, data gaps and information needs, protocols for monitoring and environmental studies, lease terms and conditions, and mitigation measures. Members of the public can attend task force meetings as observers.

Once the Bureau identifies a potential lease area, it assesses competitive interest in leasing the area by publishing either a Request for Interest or a Call for Information and Nomination.[81] Both of those documents also seek comments on the proposed lease area. Alternatively, an applicant can submit an unsolicited lease request. If the applicant is qualified, the Bureau will discuss the request with the appropriate task force before publishing a Request for Competitive Interest and comments on the proposed lease area. The Bureau may decide to defer further processing of an unsolicited lease request until a Call for Information and Nominations is issued.[82]

When more than one qualified applicant is interested in competing for a lease, the Bureau will determine the area to be made available, publish proposed and final lease sale notices, and hold a lease sale (auction). When only one applicant expresses interest, the Bureau will publish a Determination of No Competitive Interest and issue the lease non-competitively. Once a lease is issued, developers must submit a site assessment plan and/or a construction and operation plan within a certain timeframe. Site assessment plans must describe proposed activities to test technologies or assess physical resources (including plans for the construction of meteorological towers or the deployment of meteorological buoys), and must include relevant data from geological and geophysical surveys, baseline environmental surveys, and archaeological surveys. Once the developer is ready to install wind turbines, they must submit and obtain approval for their construction and operation plan, which also must include conceptual plans for decommissioning.

Cape Wind: Cape Wind, to be located off Cape Cod, Massachusetts, in Nantucket Sound, was the first offshore wind facility proposed for U.S. waters. Proposed in 2001, the developers experienced delays

[81] In 2011 the Bureau stopped publishing Request for Interest notices, as they were determined to be redundant (76 Fed. Reg. 28178). Instead the Bureau started publishing either a Request for Competitive Interest (if an unsolicited proposal has been received) or a Call for Information and Nominations (in states where competitive interest is likely and a preliminary wind energy area has been identified).

[82] The Bureau also has published a Request for Competitive Interest when only one qualified applicant has responded to a Request for Interest; however, as noted above, the Bureau is no longer publishing Requests for Interest.

early in the planning and environmental review phase, with opposition from Native Americans, residents and visitors of Martha's Vineyard and Nantucket Island, environmentalists, and fishermen. The project was further delayed when, in 2005, Congress shifted regulatory authority for offshore renewable energy to the Department of the Interior, prompting further environmental reviews. On 28 April 2010 the former Minerals Management Service signed a Record of Decision[83] choosing its preferred alternative for the project, which involved the installation of up to 130 wind turbine generators, each capable of generating 3.6 megawatts of energy for a total capacity of about 468 megawatts (enough to provide 75 percent of the electricity demand for Nantucket Island, Martha's Vineyard, and Cape Cod).[84] On 6 October 2010 the Secretary of the Interior signed a lease with Cape Wind Associates. The National Marie Fisheries Service issued an Endangered Species Act biological opinion in December 2010 concluding that the proposed action was not likely to adversely affect right, humpback, or fin whales. The Bureau subsequently approved a construction and operation plan on 18 April 2011. Under the plan, geological and geotechnical surveys were scheduled to start in fall 2011, with construction of the wind turbines to start in 2012.

The National Marine Fisheries Service announced receipt of an application from Cape Wind Associates on 14 September 2011 for the take of small numbers of marine mammals (minke whales, Atlantic white-sided dolphins, harbor porpoises, gray seals, and harbor seals) by harassment, under section 101(a)(5)(D) of the Marine Mammal Protection Act (76 Fed. Reg. 56735). The take would result from geological and geotechnical surveys to be conducted from fall 2011 through fall 2012. The Service proposed to issue the authorization, subject to certain conditions. The Commission reviewed the application, which involved the collection of high-resolution data along 4,292 km of track lines using side scan sonar, a magnetometer, depth sounders, and sub-bottom profilers. The Commission recommended that the Service require Cape Wind Associates to take additional actions to ensure that the calculations of harassment zones for the sub-bottom profilers and the associated number of takes were correct. The Commission also recommended shut-down of operations during impaired visibility conditions and monitoring of marine mammals during all proposed geophysical and geotechnical survey activities. The Commission's complete list of recommendations can be found in Appendix A. The Service completed its environmental assessment and, on 27 December 2011, published a notice of intent to issue a marine mammal incidental harassment authorization to Cape Wind Associates effective 1 January 2012 (76 Fed. Reg. 80891). In response to the Commission's recommendations, Cape Wind Associates agreed to conduct hydroacoustic monitoring during the initial deployment of the survey equipment to verify source levels and recalculate the harassment zones if needed. The surveys are scheduled to start in 2012.

Other offshore wind energy activities: In November 2009 the Minerals Management Service (now the Bureau of Ocean Energy Management) issued four limited leases (three in New Jersey and one in Delaware) for data collection and technology testing activities on the outer continental shelf under the Bureau's interim renewable energy policy.[85] None of those had been acted on at the end of December 2011. Ten regional task forces have been established for interagency consultation on wind energy areas on the outer continental shelf—Maine, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and Washington/Oregon/California. At the end of 2011, six of those task forces had identified areas suitable for leasing. Table III-9 summarizes the status of offshore wind energy planning and leasing activities by state.

Wind energy development has been progressing at a different pace in each state. For example, in anticipation of wind energy development in both state and federal waters, the New Jersey Department of Environmental Protection commissioned a large-scale, two-year study of baseline ecological and natural resources, which was completed in 2010 (Geo-Marine, Inc. 2010). Rhode Island and Massachusetts have developed management plans to help inform decision-makers regarding resources and issues associated

[83] The Record of Decision signals formal federal approval of an Environmental Impact Statement (EIS) or Environmental Assessment (EA) concerning a proposed action.
[84] http://www.boem.gov/Renewable-Energy-Program/Current-Projects/Index.aspx
[85] The Bureau granted leases to Deepwater Wind LLC (New Jersey), Fishermen's Energy of New Jersey LLC, Bluewater Wind Delaware LLC, and Bluewater Wind New Jersey Energy LLC.

Table III-9. Status of U.S. wind energy development projects on the outer continental shelf, by state (Bureau of Ocean Energy Management)

Document	ME	MA	RI (/MA)[1]	NY	NJ	DE	MD	VA	NC	WA/ OR/CA
Interim policy lease(s)					Nov 2009 (3 leases)	Nov 2009 (1 lease)				
Regional task force established	Sep 2010	Nov 2009	Nov 2009	Nov 2010	Nov 2009	Oct 2009	Apr 2010	Dec 2009	Jan 2011	Mar 2011
Potential lease area identified by task force	No[2]	Yes	Yes	No	Yes	Yes	Yes	Yes	No	
Unsolicited request	Yes 2011	No	Yes (2) 2010[3]	Yes 2011	Yes 2010[3]	No	No	Yes 2009[3]	No	
Request for interest		Dec 2010; Mar 2011	--			Apr 2010	Nov 2010			
Request for competitive interest	Planned for 2012					Jan 2011				
Determination of no competitive interest						Apr 2011[4]				
Notice of intent to prepare an EA[1]		Aug 2011	Aug 2011		Feb 2011	Feb 2011	Feb 2011	Feb 2011		
Notice of availability of draft EA					Jul 2011	Jul 2011	Jul 2011	Jul 2011		
Call for information & nominations		Planned for 2012	Aug 2011		Apr 2011	--	Planned for 2012	Planned for 2012		
Leasing area identified			Planned for 2012		Planned for 2012	--				
Proposed sale notice										
Final sale notice										
Lease sale (auction)										
Lease issuance		Oct 2010 (Cape Wind Assoc.)[6]				Planned for 2012				
Other										
Baseline studies					Yes[2]					
Management plans		Yes[8]	Yes[9]							

Lease areas for Rhode Island and Massachusetts were developed jointly as an "Area of Mutual Interest" pursuant to a 26 July 2010 Memorandum of Understanding between the two states.

[2] The state of Maine established an Ocean Energy Task Force in 2009 and has identified three potential lease areas in state waters (Boon Island, Damariscove Island, and Monhegan Island).

[3] The Bureau will use the information received from the Call for Information and Nominations to determine whether there is competitive interest in the proposed leased areas.

[4] Bluewater Wind Delaware, LLC was determined to be the only qualified applicant that responded to the Request for Competitive Interest.

[5] The purpose of the Environmental Assessment is to issue leases and approve site assessment plans for the proposed wind energy areas.

[6] The steps involved in the issuance of the Cape Wind Associates lease did not follow the same steps outlined in the table for other wind energy area projects.

[7] Geo-Marine, Inc. 2010.

[8] Final Massachusetts Ocean Management Plan (http://www.mass.gov/eea/ocean-coastal-management/mass-ocean-plan/final-massachusetts-ocean-management-plan.html)

[9] Rhode Island Ocean Special Area Management Plan (http://seagrant.gso.uri.edu/coast/osamp.html)

with renewable energy development. The Bureau published Calls for Information and Nominations in 2011 to determine competitive interest in wind energy areas off New Jersey, Rhode Island, and Massachusetts with proposed lease sale areas to be announced in 2012. The Bureau determined in 2011 that there was no competitive interest for wind energy development in Delaware offshore waters and therefore is expected to issue a non-competitive lease to Bluewater Wind Delaware, LLC in 2012. Maine and New York both received unsolicited requests in 2011 for commercial leases; those requests were still

under review in December 2011. In 2011 the Bureau anticipated leasing and site assessment activities in all four mid-Atlantic states (New Jersey, Delaware, Maryland, and Virginia) and published a draft environmental assessment for those activities in July 2011.

To provide the "backbone" grid to connect several of the proposed wind farms off the mid-Atlantic, Atlantic Grid Holdings LLC submitted an unsolicited proposal to the Bureau in March 2011 to construct a high voltage direct current, underwater transmission system. The company was seeking a right-of-way grant from the Bureau for this activity. In December 2011 the Bureau published a notice seeking comments on the proposal. Figure III-18 illustrates the proposed Atlantic Wind Connection and associated wind energy areas in the mid-Atlantic.

The Commission submitted comments to the Bureau on three wind energy-related actions in 2010 and 2011, pertaining to notices published regarding Rhode Island, Massachusetts, and the four mid-Atlantic states. The Commission's complete list of comments by action can be found in Appendix A. In summary, the Commission encouraged the Bureau to continue its proactive and collaborative approach for identifying specific leasing areas for wind energy development and to choose wind energy areas that minimize the likelihood of noise-related injuries and vessel strikes to marine mammals, especially endangered species such as the North Atlantic right whale. The Commission recommended that the Bureau require lessees to apply mitigation measures to protect all marine mammals, not just those listed as endangered or threatened under the Endangered Species Act, and to determine exclusion and buffer zones for all sound sources using operational- and site-specific information, modifying those zones as necessary using in-situ sound measurements. The Commission recommended that the Bureau also require lessees to use acoustical monitoring to characterize ambient sound levels before, during, and after proposed activities, and to monitor for the presence and movements of cetaceans in the vicinity of specific proposed wind energy areas. As with oil and gas activities, the Commission stressed the need to develop a set of standards for the collection of baseline information on marine mammals and their environment and to identify and address any significant data gaps before initiating the leasing process. The Bureau had not responded to those comments nor completed its environmental assessment by the end of 2011.

Wind energy development in state waters: Wind energy development in state waters is regulated by individual state agencies and follows state processes. State processes may include the establishment of task forces or other advisory bodies to assist in the identification of potential wind development areas. States also may require baseline studies or the collection of other information needed to determine potential environmental and socioeconomic impacts.

At least two coastal states were moving forward with wind energy development within state waters in 2010 and 2011. New Jersey-based Fisherman's Atlantic City Windfarm, LLC was preparing to construct six wind turbines 2.8 miles off Atlantic City, New Jersey, with each turbine capable of producing 3.6 megawatts. Coastal Point Energy was planning to construct a single 750 kilowatt wind turbine eight miles off Galveston, Texas. Ultimately, Coastal Point plans to build a 300 MW wind farm on 12,350 leased acres at the Galveston Wind Project site, and the Baryonyx Corporation has proposed a three-turbine, 18MW wind farm be installed off Padre Island, Texas.

Hydrokinetic energy: Hydrokinetic energy is generated from the movement of water (e.g., tides, waves, and currents).[86] While this technology is still in the development stage, several prototype projects are in use or being tested.

Tidal energy generators are the most common, primarily because of the predictable nature of tides.Tidal power generators are typically either in the form of permanent barrages (dam-like structures) or tidal stream generators (similar to wind turbines, only underwater). Dynamic tidal power is a new technology, conceptually designed to capture energy more efficiently from strong coastal tides and currents using alongshore T-shaped dam-like structures.

Wave energy devices are generally installed at or near the ocean surface and convert energy from the

[86] Hydropower, or power generated from the movement of water across dams, is generated from inland rivers and so is not included in this discussion of ocean energy sources.

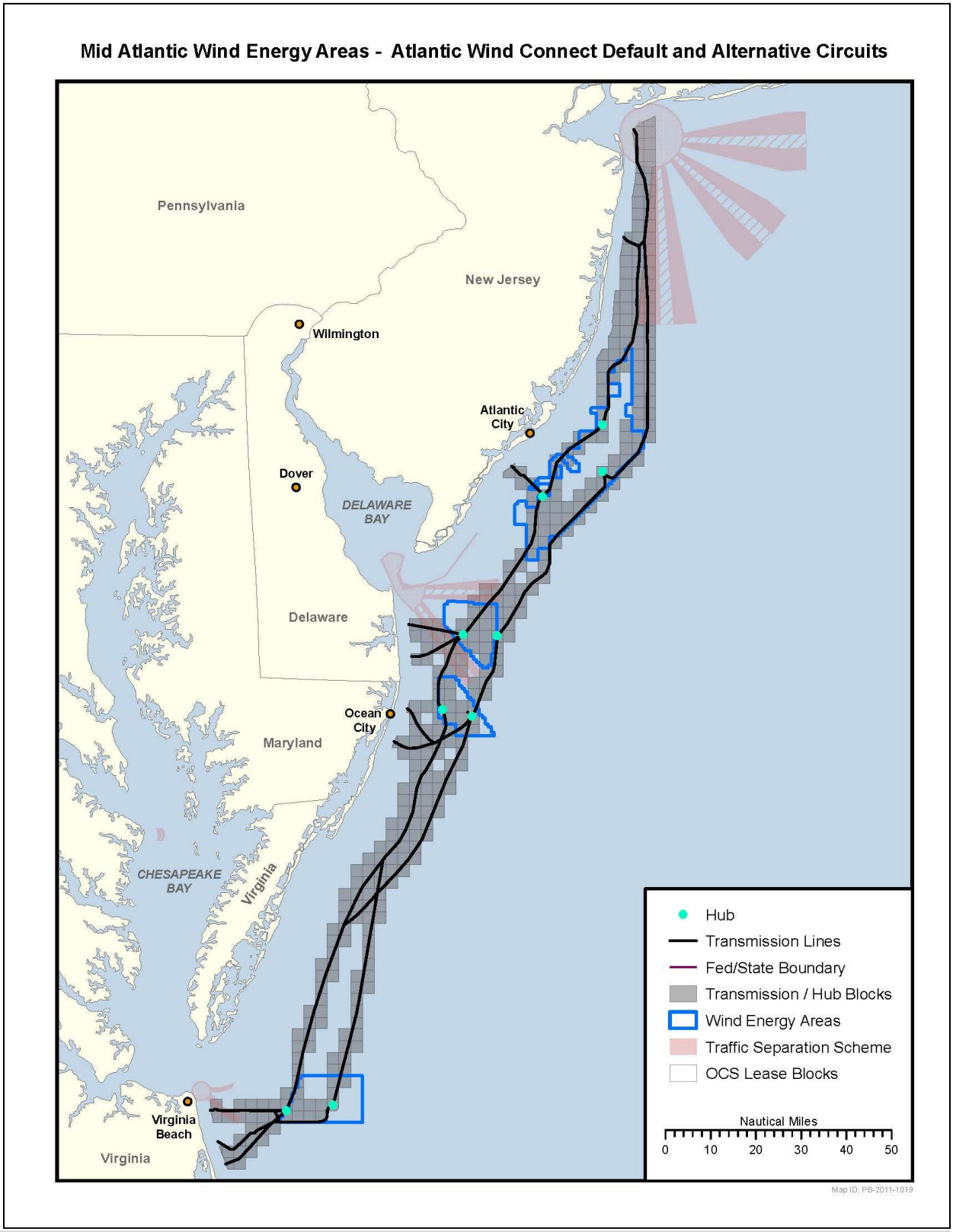

Figure III-18. Map of mid-Atlantic wind energy areas and the proposed Atlantic Wind Connection high voltage direct current transmission system. (Bureau of Ocean Energy Management)

up and down movement of waves into other energy types, usually electricity.[87] Current efforts to test those devices are focused on four main wave generators—terminators, point absorbers, attenuators, and over-topping devices. Terminators are positioned perpendicular to the waves and capture or reflect the wave power using an oscillating water column or other piston-like structure; they are generally used in nearshore waters. Point absorbers resemble anchored buoys with piston-like structures at either the ocean surface or at depth. Attenuators are long, floating structures mounted parallel to the waves so that the flexing action creates energy. Over-topping devices are similar to attenuators except they are mounted in a semi-circle to create a reservoir effect.

Current generators are the least advanced of the hydrokinetic technologies; underwater turbines or water-wheel structures are the most common devices being tested. They can either be suspended from bottom-mounted mooring systems or mounted directly to the seabed.

Worldwide, only a handful of hydrokinetic operations (most based on tidal energy) are generating reliable energy from the ocean. Leaders in tidal power generation in 2011 were South Korea (> 254 megawatts), France (240 megawatts), and Canada (20 megawatts).[88] China, Russia, and the United Kingdom also generated tidal power, but at much lower amounts (3.2, 1.7, and 1.2 megawatts, respectively).[89] Wave energy was generated at much lower levels globally, with top producers including the United Kingdom (1300 kilowatts), Canada (1065 kilowatts), Korea (500 kilowatts), Portugal (400 kilowatts), and Spain (296 kilowatts)—Denmark, Sweden, and New Zealand all generated < 200 kilowatts.[90] In the United States, small-scale and pilot hydrokinetic projects have been located on each coast, with tidal energy topping the list of permitted projects.[91]

Risks to marine mammals: The potential impacts of commercial scale hydrokinetic energy projects on marine mammals and marine ecosystems are poorly known. Several studies have been conducted around test facilities in the U.K.[92] However, one might expect impacts similar to those from wind energy, depending on the site characterization requirements and the design of the hydrokinetic device. If the structure is to be mounted to the seafloor, bottom surveys would be needed to characterize subsurface structure, with potential impacts from sound generated by sub-bottom profilers. Mounting of permanent structures on the seafloor for tidal or current turbines may involve pile driving, which generates sound that could impair hearing in marine mammals at close range or lead to changes in behavior at intermediate distances. Operation of underwater turbines has the potential to injure or kill marine mammals by direct interactions with the turbine foils. Wave attenuators or over-topping devices could present an entanglement or entrapment hazard. And activities associated with site characterization, construction, and maintenance of hydrokinetic energy presents a heightened risk to marine mammals from vessel collisions, electromagnetic disturbance, habitat degradation, and impacts on prey species.

Leasing and licensing process: Leasing of hydrokinetic energy sites is regulated either by the Bureau of Ocean Energy Management (for federal waters) or by individual states (for state waters). The Bureau follows the same process for leasing and limited leasing of hydrokinetic sites as described above for wind energy. Projects start with a federal/state/tribal planning process to identify potential lease areas before moving on to a request for competitive interest and a lease sale. Alternatively, applicants can submit an unsolicited lease request and if there is no competitive interest, the Bureau negotiates and issues a lease directly to the applicant. The states follow their own leasing processes.

Licensing of energy projects in both federal and state waters is regulated by the Federal Energy Regulatory Commission. Applicants that have been issued a lease (or for which a lease is imminent) start the license process by submitting a pre-application document to the Federal Energy Regulatory

[87] http://ocsenergy.anl.gov/guide/wave/index.cfm
[88] http://www.un-energy.org/sites/default/files/share/une/ren21_gsr2011.pdf
[89] http://www.cresp.org.cn/uploadfiles/73/613/zhejiang.html; http://www.osec.ch/de/filefield-private/files/53139/field_blog_public_files/14171; http://www.seageneration.co.uk/
[90] http://www.ocean-energy-systems.org/oes_documents/annual_reports/2010_annual_report/
[91] http://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics.asp
[92] http://mhk.pnnl.gov/wiki/index.php/DOE_MHK_Webinar_Series

Commission. At the same time, applicants submit a site assessment plan to the Bureau. The information required by the agencies in those two documents is similar, and applicants usually submit the two documents at the same time so that the agencies can coordinate the environmental review process. The Federal Energy Regulatory Commission encourages (but does not require) applicants that are seeking to study development of a hydrokinetic project to apply for a preliminary permit. The purpose of a preliminary permit is to secure priority of application for a license while the applicant conducts studies and prepares to apply for a license. Preliminary permits can be issued for up to three years.

Once the studies are completed and the information to prepare a license has been collected, the applicant files a final license application with the Federal Energy Regulatory Commission. The Commission's license application takes the place of the Bureau's requirement for a construction and operation plan. The Commission can issue licenses for either long-term commercial projects or short-term pilot projects. Pilot project licenses provide industry with the opportunity to expedite application processing and license issuance for small footprint projects to assess environmental effects and assist in information gathering for future commercial development. Alternatively, limited testing of hydrokinetic technologies can be conducted without a Commission license if the technology being tested is experimental, the project will operate for only a short time and is being undertaken for the purpose of collecting data to prepare a commercial license application, and the electricity generated would not be transmitted into or displaced from the interstate electricity grid.[93]

Hydrokinetics projects in nearshore and offshore waters: At the end of 2011, the Federal Energy Regulatory Commission had issued 31 preliminary permits for hydrokinetic projects in nearshore and offshore waters—25 for tidal energy and 6 for wave energy (Table III-10). Another 11 permits were pending—9 tidal and 2 wave (Table III-11). As noted above, proponents of projects with preliminary permits were collecting information to support a license application. No hydrokinetic projects had been licensed at the end of 2011, although three applications were pending—2 tidal and 1 wave (Table III-12).

Baseline information requirements for renewable energy development

At each stage of renewable energy development, the Bureau (for wind energy and for site assessment of hydrokinetics) and the Federal Energy Regulatory Commission (for hydrokinetics) must conduct environmental reviews of proposed actions as required by the National Environmental Policy Act of 1969.[94] Existing information on the status of marine mammal stocks falls well short of that needed to assess potential environmental impacts of renewable energy development. Lack of research infrastructure and inadequate funding are significant impediments to surveys and other assessment studies. As a result, most studies to date have focused on specific topics rather than consistent, long-term collection of baseline information. Collection of baseline information to provide the knowledge needed to detect any adverse impacts associated with energy development and otherwise provide a strong foundation for responsible management of marine ecosystems requires a long-term commitment of effort and resources.

The Marine Mammal Commission has long argued that the industry and regulatory agencies have a shared responsibility to support the research needed to investigate the potential effects of energy development. In fact, the former Minerals Management Service has contributed significantly to marine mammal science over past decades. However, the resources still fall short of what is needed, and the Commission believes that the Bureau and the industry need to find additional means to support essential research. The industry, in particular, should provide more support because the risks stem from their activities. Addressing the environmental risks in a responsible manner should be considered a cost of doing business for industry.

[93] http://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics/pdf/mms080309.pdf

[94] Proposed wind projects must also comply with other federal and state laws, such as the Marine Mammal Protection Act, the Endangered Species Act, the National Environmental Policy Act, the Coastal Zone Management Act, the Magnuson-Stevens Fishery Conservation and Management Act, the National Historic Preservation Act, the Clean Water Act, the Clean Air Act, and others.

Table III-10. Hydrokinetic projects issued preliminary permits as of December 2011, by state (Federal Energy Regulatory Commission)

Project name	Developer	Location	Permit issued	Permit expires	Type of energy	Capacity (KW)
Alaska						
Cook Inlet Tidal Energy	Ocean Renewable Power Co. Alaska, LLC	Cook Inlet	13 Oct 2010	30 Sep 2013	Tidal	1000
East Foreland Tidal Energy	Ocean Renewable Power Co. Alaska 2, LLC	Cook Inlet	11 Mar 2011	28 Feb 2014	Tidal	100,000
Gastineau Channel Tidal	Natural Currents Energy Services, LLC	Gastineau Channel	30 Apr 2010	31 Mar 2013	Tidal	400
Icy Passage Tidal	Natural Currents Energy Services, LLC	Pacific Ocean (AK)	30 Apr 2010	31 Mar 2013	Tidal	300
Killisnoo Tidal Energy	Natural Currents Energy Services, LLC	Killisnoo Inlet	21 Jan 2011	31 Dec 2013	Wave	250
Turnagain Arm Tidal	Turnagain Arm Tidal Energy	Cook Inlet	5 Feb 2010	31 Jan 2013	Tidal	2,200,000
California						
Fort Ross (South)	Sonoma County Water Agency	Pacific Ocean (California)	9 Jul 2009	30 Jun 2012	Wave	5000
San Francisco Bay Tidal Energy	Golden Gate Energy Co	San Francisco Bay	4 Feb 2010	31 Jan 2013	Tidal	10,000
San Onofre OWEG Electricity Farm	JD Products, LLC	Pacific Ocean (CA)	29 Oct 2010	30 Sep 2013	Wave	3,186,000
Hawaii						
Oceanlinx Maui	Oceanlinx Hawaii, LLC	Pacific Ocean	25 Nov 2009	31 Oct 2012	Wave	2700
Maine						
Cobscook Bay Tidal Energy	Ocean Renewable Power Co. Maine, LLC	Cobscook River	13 Jan 2011	31 Dec 2013	Tidal	750
Half Moon Tidal Energy	Tidewalker Assoc.	Passamaquoddy Bay	3 Dec 2010	30 Nov 2013	Tidal	9000
Homeowner Tidal Power Electric Generation	Shearwater Design Inc.	Kennebec River	1 Jul 2009	30 Jun 2012	Tidal	60
Kendall Head Tidal Energy	Ocean Renewable Power Co. Maine, LLC	Atlantic Ocean (ME)	13 Jan 2011	31 Dec 2013	Tidal	1200
Pennamaquan Tidal Power Plant	Pennamaquan Tidal Power, LLC	Pennamaquan River	1 Mar 2011	28 Feb 2014	Tidal	21,100
Town of Wiscasset Tidal Resources	Town of Wiscasset	Sheepscot River	28 May 2009	30 Apr 2012	Tidal	10,000
Western Passage OCGen Power	Ocean Renewable Power Co. Maine, LLC	Atlantic Ocean (Maine)	13 Jan 2011	31 Dec 2013	Tidal	1200
Massachusetts						
Cape Cod Tidal	FFP Mass 1, LLC	Hog Island Channel	9 Dec 2010	30 Nov 2013	Tidal	20,000
Muskeget Channel Tidal Energy	Town of Edgartown	Muskeget Channel	2 Aug 2011	31 Jul 2014	Tidal	4940
New Hampshire						
General Sullivan and Little Bay Bridges UNH Tidal Energy Device Testing	University of New Hampshire	Piscataqua River	30 Sep 2009	31 Aug 2012	Tidal	0
New Jersey						
Cohansey River Tidal Energy	Natural Currents Energy Services, LLC	Cohansey River	1 Sep 2011	31 Aug 2014	Tidal	3000
Highlands New Jersey Tidal Energy	Natural Currents Energy Services, LLC	Shrewsbury River	11 Jan 2011	31 Dec 2013	Tidal	3000
Hoffman's Marina Tidal	Natural Currents Energy Services, LLC	Manasquan River	11 Jan 2011	31 Dec 2013	Tidal	200
Salem Tidal Energy	Natural Currents Energy Services, LLC	Salem River	2 May 2011	30 Apr 2014	Tidal	3000
New York						
Astoria Tidal Energy	New York Tidal Energy Co.	East River	10 Jan 2011	31 Dec 2013	Tidal	200
Astoria Tidal Energy	New York Tidal Energy Co.	East River	10 Jan 2011	31 Dec 2013	Tidal	2000

Project name	Developer	Location	Permit issued	Permit expires	Type of energy	Capacity (KW)
Wards Island Tidal Power	Natural Currents Energy Services, LLC	East River	17 Apr 2009	31 Mar 2012	Tidal	96
Oregon						
Coos Bay OPT Wave Park	Oregon Wave Energy Partners 1, LLC	Pacific Ocean (Oregon)	10 Aug 2010	31 Jul 2013	Wave	100,000
Douglas County Wave and Tidal Energy	Douglas County	Umpqua River	6 Oct 2010	30 Sep 2013	Wave	3000
Washington						
Admiralty Inlet Tidal Energy	Public Utility District No. 1 of Snohomish County	Puget Sound	8 Jul 2010	30 Jun 2013	Tidal	1000
Deception Pass Tidal Energy	Public Utility District No. 1 of Snohomish County	Puget Sound	4 Aug 2010	31 Jul 2013	Tidal	6400

Table III-11. Hydrokinetic projects pending permits as of December 2011, by state (Federal Energy Regulatory Commission)

Project name	Developer	Location	Permit filed	Type of energy	Capacity (KW)
California					
Green Wave Mendicino	Green Wave Energy Solutions, LLC	Pacific Ocean (CA)	26 Sep 2011	Wave	100,000
Green Wave San Luis Obisbo Wave Park	Green Wave Energy Solutions, LLC	Pacific Ocean (CA)	26 Sep 2011	Wave	100,000
Maine					
Lubec Narrows Tidal Energy Project	Ocean Renewable Power Company, LLC	Johnson Bay/Lubec Narrows	2 Dec 2011	Tidal	600
Treat Island Tidal Energy Project	Ocean Renewable Power Company, LLC	Passamaquoddy Bay	2 Dec 2011	Tidal	2,250
New Jersey					
Avalon Tidal Energy Project	Natural Currents Energy Services, LLC	Ingram Thoroughfare	15 Jul 2011	Tidal	3000
BW2 Tidal Energy Project	Natural Currents Energy Services, LLC	Maurice River	13 Jul 2011	Tidal	1000
Cape May Tidal Energy Project	Natural Currents Energy Services, LLC	Cape May Canal	18 Jul 2011	Tidal	3000
Dorchester - Maurice Tidal Energy Project	Natural Currents Energy Services, LLC	Maurice River	13 Jul 2011	Tidal	1500
Margate Tidal	Natural Currents Energy Services, LLC	Beach Thoroughfare	13 Jul 2011	Tidal	3000
Maurice River Tidal Energy Project	Natural Currents Energy Services, LLC	Maurice River	18 Jul 2011	Tidal	3000
New York					
Orient Point Tidal Energy Project	Natural Currents Energy Services, LLC	Long Island Sound	6 Dec 2011	Tidal	5000

Table III-12. Pending and issued licenses for hydrokinetic projects as of December 2011 (Federal Energy Regulatory Commission)

Project name	Developer	Location	License filed	License issued	Type of energy	Capacity (KW)
Reedsport OPT Wave Park	Ocean Reedsport OPT Wave Park, LLC	Pacific Ocean (OR)	29 Jan 2010	Pending	Wave	
Roosevelt Island Tidal Energy Project - Pilot	Verdant Power, LLC	East River, NY	29 Dec 2010	Pending	Tidal	1,050
TideWorks	TideWorks, LLC	Sasanoa River, ME	15 Jan 2010	Pending	Tidal	22,000

Guidelines for biological surveys: The industry needs appropriate guidelines for environmental studies. In April 2011 the Bureau issued guidelines for shallow hazard surveys, geological surveys, geotechnical surveys, and archaeological resource surveys required for development of wind energy

resources.[95] It did not, however, issue guidelines for biological surveys, even though lessees also must submit the results of biological surveys with their site assessment and construction and operation plans. The Marine Mammal Commission understands that the Bureau is in the process of developing those guidelines and provided comments on a draft version in March 2011. In its 11 August 2011 letter to the Bureau, the Commission requested an opportunity to review and provide comments on future drafts to facilitate their completion. Clear and comprehensive guidelines should help the Bureau and industry avoid significant gaps in baseline information. The Commission recommended also that the Bureau work with lessees to ensure the availability of adequate baseline information before moving forward with wind energy site characterization and assessment projects. The Bureau awarded a project entitled "Developing Environmental Protocols and Monitoring to Support Ocean Renewable Energy and Stewardship" under the National Ocean Partnerships Program in 2010. At the end of 2011 the Bureau expected to continue to work with the Commission on these guidelines and it expected to complete the guidelines in 2013.

Research and environmental monitoring: As noted in the previous section, the Bureau plays an essential role in environmental research and monitoring of offshore renewable energy development. Its Environmental Studies Program can provide significant information on baseline environmental conditions in renewable energy leasing areas and can support research into the effects of renewable energy development on marine mammals and the effectiveness of mitigation and monitoring measures. As also noted in the previous section, in 2009 the Bureau, in collaboration with the Navy, committed to providing multi-year funding to the National Marine Fisheries Service for the Atlantic Marine Assessment Program for Protected Species (AMAPPS). The Bureau also supported a number of other research and monitoring studies completed or ongoing in 2011 to help identify and address data gaps on the effects of renewable energy development on marine mammals.[96] They included—

- a marine mammal and sea turtle data search and literature synthesis including stranding and nesting sites (Atlantic Coast);
- development of a national marine mammal data archive (nationwide);
- high definition video surveys for seabirds, marine mammals, and sea turtles (Atlantic Coast);
- marine mammal and seabird surveys of potential alternative energy sites (northern California, Oregon, and Washington);
- a review of the effects of electromagnetic fields from transmission lines on elasmobranchs and other marine species, including marine mammals (worldwide) (Normandeau et al. 2011);
- opportunistic study of hearing in sea otters (*Enhydra lutris*) (Pacific Coast) and measurement of auditory detection thresholds for tonal and industry sounds (Chukchi Sea);
- characterization of potential impacts of noise producing construction and operation activities for renewable energy development (Gulf of Mexico);
- mitigation of underwater pile driving noise during offshore construction of offshore wind farms (nationwide) (Stokes et al. 2010);
- support for the second international conference on the effects of noise on aquatic life (worldwide); and
- support for the 19th biennial conference on the biology of marine mammals (worldwide).

Commission staff participated in several Bureau-related projects related to wind energy. The Commission's energy policy analyst served in an advisory capacity to the University of Rhode Island, which was funded by the Bureau to develop "environmental protocols and modeling tools to support ocean renewable energy and stewardship." Commission staff provided extensive comments on the Bureau's draft guidelines for the assessment and monitoring of protected species and fish and their

[95] http://www.boem.gov/Renewable-Energy-Program/Regulatory-Information/GGARCH.aspx
[96] http://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Renewable-Energy/Renewable-Energy.aspx

habitats in the Atlantic for offshore wind development. In December 2010, the Commission endorsed the nominations of two members to the Bureau's Scientific Advisory Committee for the Environmental Studies Program and Commission staff attended the Bureau's 2011 meeting of the Committee, where ongoing and proposed research projects were reviewed. Commission staff also attended the Bureau's two-day Atlantic Wind Energy Workshop, which provided updates on current research and management actions (Cahill et al. 2011).

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